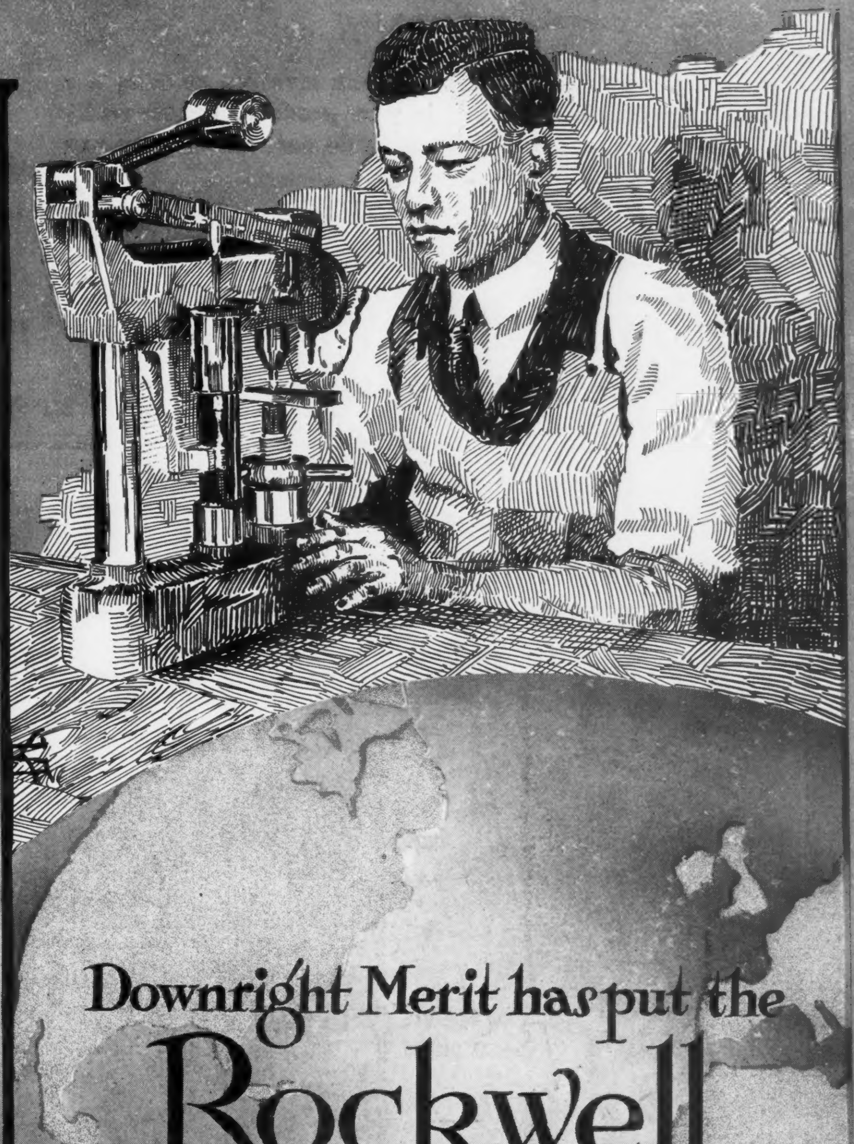
DECEMBER 1926—THIRTY-THIRD YEAR

MACHINERY

THE INDUSTRIAL PRESS Publishers, 140-148 LAFAYETTE ST., NEW YORK



MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 33 DECEMBER, 1926 Number 4

PRINCIPAL ARTICLES IN THIS NUMBER

DEPARTMENTS

Total Distribution for November, 16,855 Copies

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS, 140-148 LAFAYETTE STREET, NEW YORK

ALEXANDER LUCHARS, President ROBERT B. LUCHARS, Vice-President EDGAR A. BECKER, Treasurer
ERIK OBERG, Editor FRANKLIN D. JONES, Associate Editor CHARLES O. HERB, Assistant Editor FREEMAN C. DUSTON, Assistant Editor
LONDON: 52 Chancery Lane PARIS: 15 Rue Bleue

YEARLY SUBSCRIPTION: United States and Canada, $3 (two years, $5); foreign countries, $6. Single copies, 40 cents.

How old are your Planers?

Ten years ago many users believed that the planer had nearly reached its final development; but during the intervening period, unceasing effort, skill and experience have kept that machine abreast of the most advanced tools.

The modern planer produces more work because it is more convenient. Without moving from his normal working position the operator can simply push a button to start or stop the driving motor, turn a crank to clamp or unclamp the rail, pull a handle to set the rail at the desired height, operate levers to engage rapid traverse mechanisms for each head, and set dials to select any feed of either the rail or side heads. These conveniences save the operator's time, eliminate unnecessary motions and increase his output.

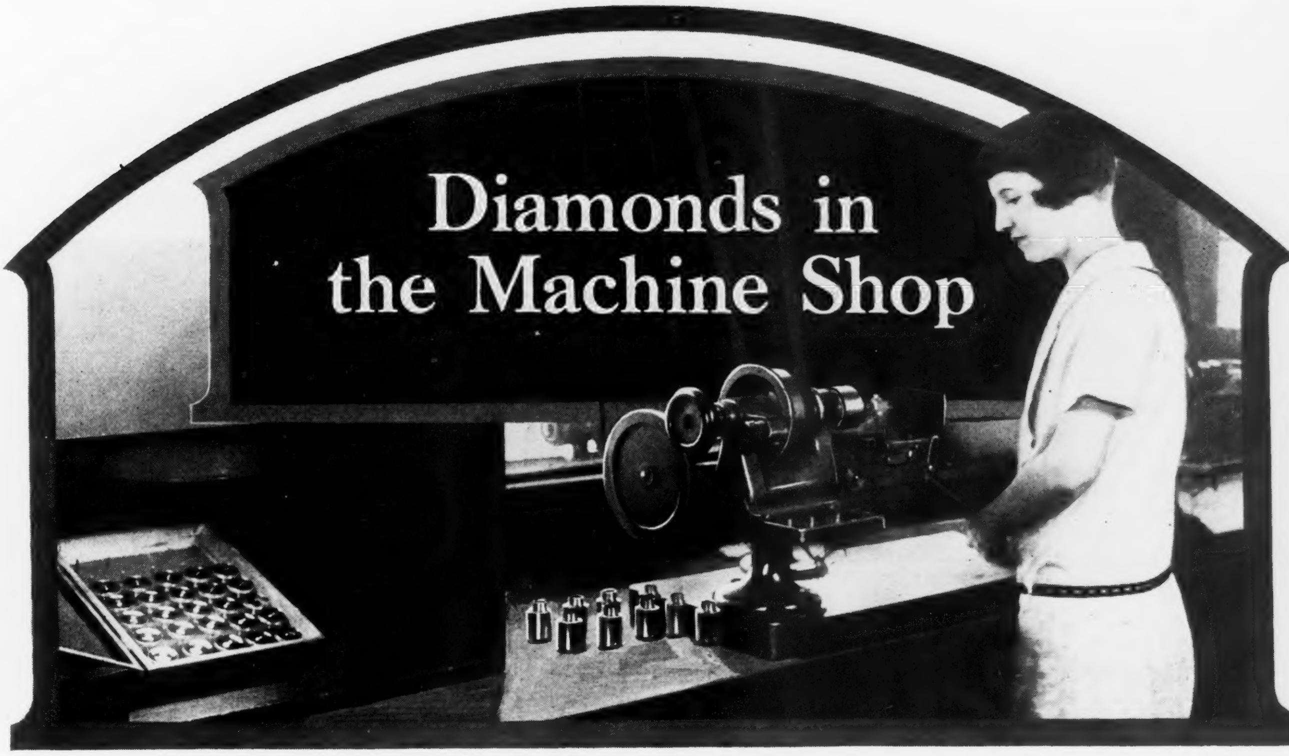
Another reason why the modern planer produces far more work than old planers is that cutting speeds have been increased to make full use of the improved cutting steels now available. The gears are made from steel and they run in oil; the proportions of the machine are far heavier, affording rigid support to the work and the cutting tools. The work produced is better and there is far less need of scraping; the machine is safer to operate and it is better safe-guarded against the operator's carelessness.

Many shop executives are not yet aware of these important developments, and in many shops the planers are the oldest machines in operation. Executives replace other types of machine tools long before they replace planers.

Planers thirty, forty and even fifty years old are to be seen in many shops; but they have neither the speed, the power, the accuracy, nor the convenience of the modern planer. While these old planers still "run"—money is running out of the pockets of their owners into the pockets of their competitors who have had the wisdom and courage to install modern planers.

How old are YOUR planers?

Diamonds in the Machine Shop



Lathe and Milling Machine Operations in which a High Degree of Accuracy and Finish are Obtained by Using Diamonds for Cutters

By CHARLES O. HERB

THAT nothing made by man can be absolutely perfect is an indisputable fact; nevertheless "perfect" is the term given on drawings in designating the required accuracy of quite a number of metal parts produced at the plant of the Bausch & Lomb Optical Co., Rochester, N. Y. When these parts are inspected by means of indicating gages, there must be no perceptible variation of the indicator needle from the zero graduation.

In boring one part to a diameter of 14 millimeters (0.5516 inch) for a depth of approximately 1 inch, the movement of the cross-slide on which the boring tool is mounted actuates a lever which magnifies the movement five times against the spindle of an indicator gage. The operator observes the indicator dial through a strong magnifying glass, and when the final cut is taken on each successive piece of work, there must be no noticeable deviation of the needle from the center of the zero graduation. The high accuracy of these parts is attained by using diamonds for cutting tools. Typical applications of these tools are described in this article.

Advantage of Using Diamonds for Metal Cutting

In addition to the high accuracy attained by machining parts with diamonds, there is the advantage of a brilliant finish. As the parts come from the machines they look as though they had been put through a buffing or burnishing process. Some of the parts do not need to be accurate, but are prominent on instruments in which they are assembled, and are merely machined with diamonds in order to give them a high polish. After these parts are taken from the machines, they are lacquered to preserve the polish. One advantage of the use of diamonds over buffing for producing a high polish is that the edges of diamond-turned parts are left sharp and not rounded slightly.

Diamond tools can be used indefinitely without regrinding, which is an economical feature of considerable importance. In turning brass tubing, diamonds have been used continuously for eighteen months without any regrinding. One of the secrets in the successful use of diamonds for metal cutting, is that the work must always revolve before the diamond is brought in contact with it; otherwise the sudden impact in starting up the work is likely to break off the cutting edge. When the work is revolving, however, intermittent cuts can readily be taken without any danger of the diamond being injured. An excellent example of this sort is shown at *A*, Fig. 1. The entire convex top surface of this part is faced to a mirror-like finish with a diamond which "jumps" across the two large holes and machines the entire circumferential edges of these holes clean and sharp.

Most metal parts machined on a production basis in this plant are made of brass, bronze, aluminum, or German silver, but diamonds are also successfully used from time to time in machining steel and cast-iron parts. In operations on the latter metals, the feeds used are as great as and sometimes even greater than those ordinarily employed with high-speed steel tools. It has been found that sand holes in iron castings do not damage the cutting edge of diamonds. Large quantities of brass castings up to 12 inches in diameter and 3 feet in length have been finished to size within 0.0002 inch over the entire length, while taking cuts 1/16 inch deep. In these operations, the cuts have been taken over the outside scale of the castings.

Fig. 1. Parts turned or faced in Lathes employing Diamonds as Cutting Tools

The accuracy over the entire length of the parts is possible only because of the non-wearing property of diamonds. In turning aluminum with diamonds, there is no "tearing" of the metal.

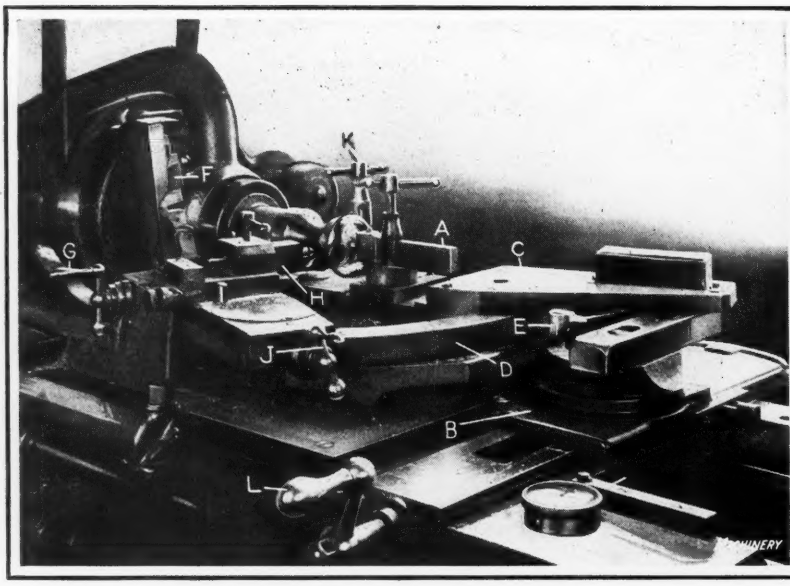


Fig. 2. Attaining an Accurate and Brilliant Finish on Microscope Nose-pieces by turning and facing with Diamonds

Using Diamonds in Lathe Operations

The principal application of diamonds for metal-working in the Bausch & Lomb plant is on lathes. Each of these lathes is furnished with special equipment that facilitates quantity production. In all lathe operations, the work is run at from 1500 to 2000 revolutions per minute, and the depth of cut varies from 0.016 to 0.022 inch for roughing cuts, and from 0.006 to 0.012 inch for finishing cuts.

Fig. 1 shows typical examples of parts machined in lathes. The part shown at *A* is an aluminum nose-piece for microscopes. This example is approximately 2 1/4 inches in diameter, and is rounded on the top surface to a radius of 2.130 inches. In addition to the diamond tool employed for finishing the top surface, a second diamond finishes a 3/16-inch wide bevel surface adjacent to the rim on the bottom side. There is also a high-speed steel tool which chamfers an internal edge of the bevel surface, and a second steel tool which removes the sharp edge produced where the top and bevel surfaces join.

When the part comes to the diamond-turning lathe, which is illustrated in Fig. 2, the inside surfaces are already finished, and these surfaces are seated on an expanding collet chuck of special design. The convex top surface is turned by a diamond held in holder *A*, which is fed from the middle of the part to the outside. With the work revolving, the tool is advanced to start the cut, and then the regular feed of cross-slide *B* is engaged to feed the slide toward the front of the machine. The movement of the cross-slide is conveyed through the medium of part *C* to the swivel rest on which the tool-block is mounted. The swivel rest is rounded at the right-hand end to match the curved guide *D*, which takes the thrust of the cut. At the end of the cut, the operator depresses knob *E* to release a half nut from the cross-feed screw, after which the cross-slide can be quickly pushed to the rear of the bed. A stop which the carriage comes in contact with, serves to locate this diamond tool correctly for each piece of work.

While the cut on the top of the nose-piece is in progress, the operator drops the hinged block *F*, on which a steel tool is mounted, into position for turning the chamfer on the inside of the bevel portion. For this cut, the tool is positioned by turning handle *J*, and is advanced across the surface by turning handle *G*. Micrometer graduations on handle *J* facilitate the proper setting of the tool. A diamond tool in holder *H* is next advanced, by means of handle *G*, into the proper position for turning the bevel surface, and is then fed across this surface by revolving handle *J*. Handle *G* is also provided with micrometer graduations to enable the tool to be set for the correct depth of cut. Finally, a high-speed steel tool mounted in holder *K* is employed to remove the sharp edge formed by turning the top and bevel surfaces. Holder *K* is mounted on the same swivel rest as holder *A*, and the cut is taken as the operator turns handle *L* to quickly feed cross-slide *B* forward against a stop.

A gage provided with three dial indicators is employed to check the accuracy of the various important surfaces machined in this operation. For the part to pass inspection, there must be no noticeable deviation of any of the indicator needles from the center of the zero graduation.

An important factor in successful diamond turning or boring is that there must be an entire absence of play between the headstock spindle and its bearings. When a machine is first started up in the morning or at the end of the noon lunch period, the spindle must be run idle from fifteen minutes to one-half hour, so as to heat the spindle and thus expand it to a snug fit in the bearings. When this is not done, it is impossible to attain the required accuracy and polish on work.

In turning operations, the diamond is ordinarily set to the center of the work, but when a finish of exceptional brilliance is desired, the diamond is set a very slight amount higher. Usually the setting is determined by a cut-and-try process. Girls are used entirely as machine operators in this department.

The brass casting shown at *B*, Fig. 1, has a taper shank or axle on which the nose-piece is assembled, and it is im-

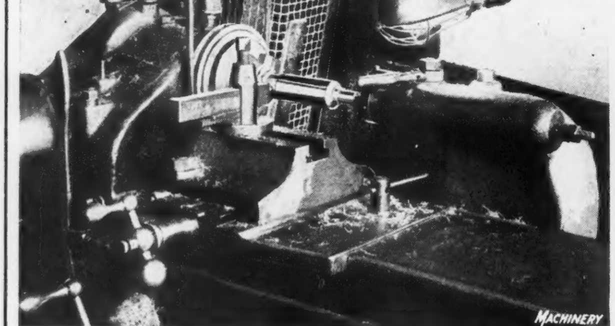


Fig. 3. Diamond-turning a Microscope Body Tube which is held within Close Limits for the Entire Length

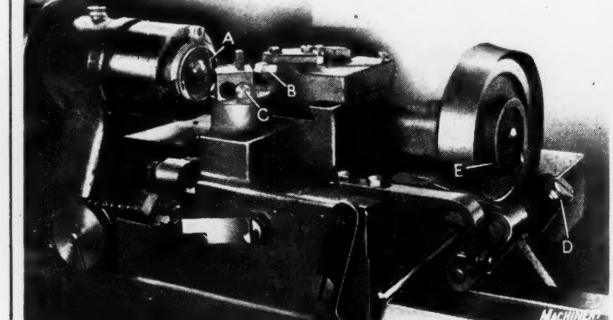


Fig. 4. Automatic Equipment used in giving a High Polish to an Adjustment Button

portant that the two parts be closely finished so as to insure a snug fit. The axle is about 3/8 inch in diameter at the large end and has a taper of 20 degrees included angle. The shoulder at the large end of the taper must be held to a certain height above the curved portion of the part within close limits. When in the chuck, the curved surface seats against the inside front wall of the chuck, and the axle and shoulder extend through a hole in the wall, as may be seen at *X* in Fig. 5. After the work has been inserted in the chuck, block *A* is swiveled into line with the work. Then a small wheel at the left-hand end of the headstock is revolved to advance a screw in the center of the spindle against the back end of block *A* and thus clamp the block and work in place for the operation.

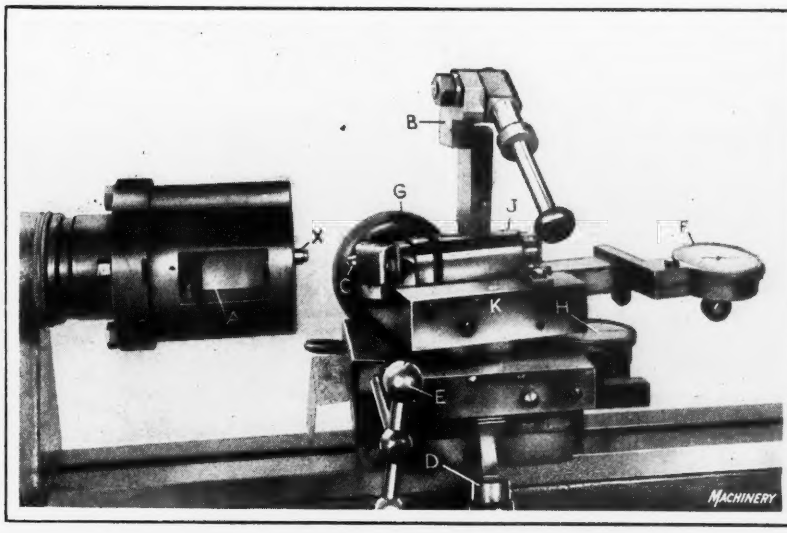


Fig. 5. Equipment employed for accurately turning a Taper Axle and facing an Adjacent Shoulder

In an operation, a necking cut is taken close to the shoulder of the axle by means of a high-speed steel tool mounted on the hinged holder *B*, which is swung down and locked in position for the cut. Then the diamond tool in holder *C* is employed for turning the axle and facing the shoulder. In taking preliminary cuts on the shoulder, the tool is fed back and forth several times by raising and lowering handle *D*. The final cuts are taken by feeding the cross-slide by means of handle *E*, and when the shoulder is finished, the needle of indicator *F* must register as closely as possible in the middle of the zero graduation.

The final cuts on the shoulder are taken after the taper axle has been finished. This surface is machined by advancing housing *J* by means of handwheel *G* to feed diamond-holder *C* along the work, rest *K* in which housing *J* slides being set at the proper angle to suit the taper of the axle. Several cuts are taken along the axle, and the correct size, as regards diameter, is obtained when the needle of indicator *H* registers in the middle of the zero graduation. At the end of the operation, a gage is applied to check the height of the shoulder above the face of the chuck.

Large quantities of German silver parts such as shown at *D*, Fig. 1, are produced. The bevel portion is diamond-turned in a lathe in which the work-holding spindle is positioned at the proper angle relative to the cross-slide to permit machining the bevel by feeding the diamond across it by revolving the cross-feed screw. When all diamond-turned parts are taken from the machines, they are placed in receptacles and slipped over pegs, so that they cannot bear against each other and mar their finish.

Finishing Brass Pieces

In turning brass, the chips produced in the roughing cuts form a continuous curl, whereas in the finishing cuts, the chips break off short. Fig. 3 shows a diamond-turning operation on a microscope body tube, which is about 3/64 inch thick when finished. This part is also diamond-bored in another operation. The tubes come to the machine from 0.003 to 0.004 inch large, and when finished, must be true as regards both diameter and concentricity.

The body of the microscope is assembled over another part, and the fit between the two parts must be such as to exclude all light. At the end of the finish-turning, the name and address of the Bausch & Lomb Optical Co. are rolled on the outside of the tube while the part is supported on an arbor in a hand milling machine, the impression being made by marking dies which are fed along the tube by advancing the table of the machine.

In machining these microscope body tubes, roughing and finishing cuts are taken in two different machines of similar set-up, which are run by the same operator that does the marking. The arbor on which the work is mounted is forced into the tubes by striking with a wooden mallet. This arbor is held between the centers of the lathes as illustrated. An accurate diameter of the tubes is attained by setting the handwheel of the cross-slide screw to the proper graduation on the micrometer collar, in taking the final turning cut.

The example shown at *E*, Fig. 1, is a brass button or wheel which is machined by means of a diamond to secure a high polish, as one or more of these wheels are prominent on various instruments manufactured by the company. The part is of brass, and consists of a head and a shank on the opposite side, about 1/2 inch long. When these buttons are taken from the lathe, they are slipped over pegs in a wooden box, which is placed in the cabinet seen at the left in the

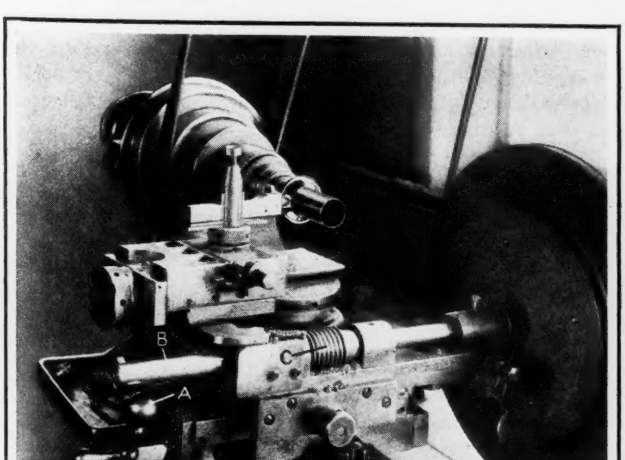


Fig. 6. Automatically turning a Curved Surface on a Brass Part

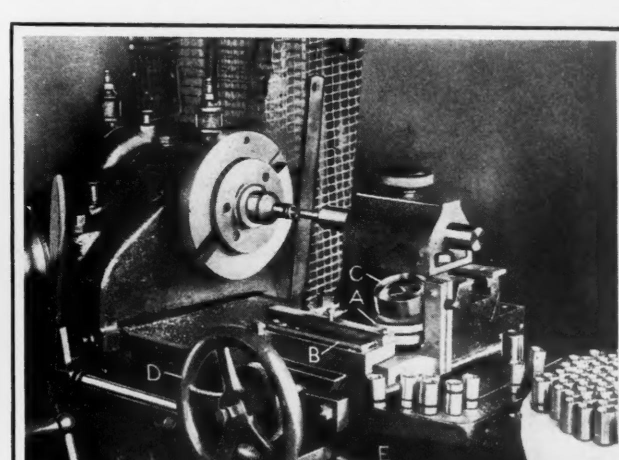


Fig. 7. Boring a Small Part to an Unusually High Degree of Accuracy

heading illustration. A blue Mazda 100-watt lamp in the top of the cabinet shines on these buttons and shows up the most minute defect on the polished surface. The polished surface is untouched by hands until after it is lacquered.

Fig. 4 shows the lathe employed for the operation on the pinion buttons. As seen at *A*, the part is held in a Star chuck, in which the shank extends back into the chuck but is not clamped, the knurled periphery of the button head being gripped by three curved pieces. In the operation, the central raised boss of the top side of the head is machined by means of a high-speed steel tool *B*, which gives a "frosted" appearance in contrast to the highly polished remainder of the button top. The highly polished surface is finished by means of a diamond tool mounted in holder *C*, which is contained in a block that must be swiveled in taking the cut. Running along the rear of this machine is a shaft which delivers power through worm-gearing to a second shaft on which a cam is mounted for actuating the tools.

Both tools are located for cutting by advancing the carriage against a stop. Then the feed is engaged, and as the cam revolves, it feeds the steel tool toward the front of the machine to face the central hub. At the same time, an arm causes the post on which the diamond-holding block is mounted, to swivel and thus carry the diamond across the work. In the normal set-up of the machine, roller *D* bears against cam *E* on the face of the worm-wheel. As each operation is finished, the high point of this cam forces the roller a slight amount to the right, and this movement is imparted to the entire carriage, withdrawing the tools sufficiently from the work to prevent marring the finished surfaces as the tools are returned to their starting position.

The part illustrated at *F*, Fig. 1, is a microscope eye-piece adapter; the outside portion of the tube and the curved section between the tube and the knurling are turned by diamonds. Fig. 6 shows the machine employed for turning the curved portion, which is done simply for the sake of appearance. The part is seated on an ordinary expansion chuck, and the tool is fed into the starting position by turning handle *A*, which revolves the cross-slide screw. Then end *B* of the shaft on which worm *C* is mounted is pulled toward the left to engage the rotating worm with a worm-wheel mounted on the fixture which carries the tool-slide. As the worm-wheel revolves, the tool is swiveled across the work to finish the surface to the desired radius. The worm drive is automatically disengaged at the end of the operation.

An Unusual Boring Operation

Reference was made at the beginning of the article to a boring operation of unusual accuracy. This operation is il-

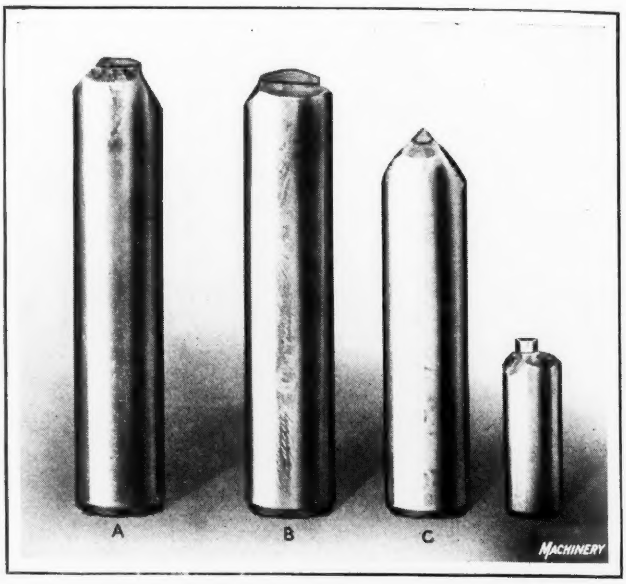


Fig. 9. Holders with Diamonds ground for Various Metal-cutting Operations

lustrated in Fig. 7, and consists of boring the bronze lens sleeve *C*, Fig. 1, to a diameter of 14 millimeters (0.5516 inch) for a depth of approximately 1 inch to a shoulder. In the operation, transverse movements of the cross-slide and tool, to obtain the specified diameter of the hole, are registered on dial indicator *A*, Fig. 7.

This is accomplished by means of lever *B*, one end of which is actuated by a rod that moves with the cross-slide, while the opposite end contacts with the spindle of dial indicator *A*. Lever *B* is pivoted near the left-hand end and amplifies the movement of that end five times against the indicator spindle, with the result that the movement of the indicator needle is five times as great as that of the diamond. The movements of the needle are observed through a strong magnifying glass *C*. Successive cuts are taken on the bore of the work until the indicator needle registers as nearly in the middle of the zero graduation as can be determined through the magnifying glass.

About 0.006 inch of stock is removed in the first cut, and about 0.0003 inch at each successive advance of the diamond. Handwheel *D* is revolved to position the diamond approximately for an operation, and then the smaller wheel *E* is employed to adjust the diamond for the cuts. Wheel *E* actuates a fine-thread worm which engages a worm-wheel mounted on the same shaft as handwheel *D*. Obviously, this facilitates the slight adjustment of the diamond between the successive cuts. The end of the lens piece opposite to that bored has a finely tapped hole in it, and so the work is held for the operation by screwing the part on a threaded stud in the center of the chuck. The depth of the bore is governed by a stop, which trips the feed as the diamond reaches the shoulder in the far end of the part. Lens cells, which are later fitted into the sleeves, are also turned to the same degree of accuracy.

Machining Flat Surfaces with Diamonds

Another unusual operation is illustrated in Fig. 8; this consists of finishing both flat sides of a brass casting *A*, of very irregular outline, on a milling machine. The casting is about 6 inches long over-all, and must be finished to a thickness of 0.3125 inch within 0.0005 inch over the entire length. The operation is especially interesting because of the intermittent cuts and because of the fact that a gripping pressure cannot be exerted on the part without causing warpage, so that a special means of holding must be employed.

The part is simply laid on a block, with one end against a stationary jaw, and then the adjustable jaw is advanced so that it just touches the opposite end. Two feed-screws of the adjustable jaw bear against blocks at the left-hand end of the table to furnish additional support. Block *B* is in-

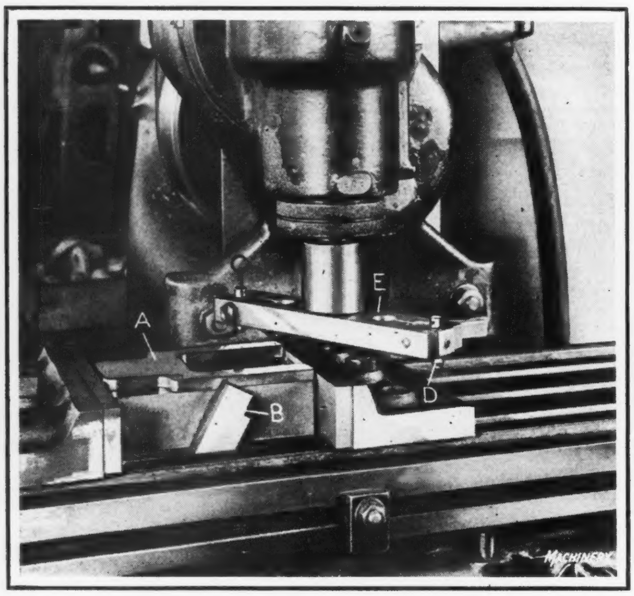


Fig. 8. Finishing Both Sides of a Part of Irregular Outline on a Milling Machine

serted in a T-slot on one side of the work to take the thrust of the cut and prevent the work from shifting.

Two diamonds contained in holders *C* and *D* are employed in this operation, the diamonds being located about 8 inches apart in bar *E*. The holders can be swiveled and clamped in any position to bring the cutting points of the diamonds in the desired relation to the surface being machined. The first diamond takes a free cut up to 1/16 inch deep, depending upon the amount of stock that must be removed, while the second diamond takes a burnishing cut about 0.002 inch deep. When one side is finished, the part is reversed for finishing the other side. In addition to the parallelism of the two sides which is obtained by finishing with diamonds, another advantage is that all edges are finished sharp and clean. Cutter bar *E* is run at about 300 revolutions per minute, and the feed of the table is about 0.007 inch per revolution of the cutter-bar. Prior to coming to the milling machine, this part is rough-milled and heat-treated to remove all strains.

Selecting the Diamonds

Brown Brazilian or African diamonds of the same properties as brilliant gems, with the exception of being off color, are used exclusively in this plant for metal-cutting. Before diamonds of this quality were decided upon, experiments were conducted over a period of several years. Black or "carbon" diamonds of the kind used in dressing grinding wheels were first used, and while satisfactory results were obtained in cutting rubber, bakelite, etc., these diamonds were found unsuited for the precision cutting of metals. It is essential that the diamonds used for this purpose be of close grain and free from carbon spots, so that a keen cutting edge may be ground.

The diamonds are set into 3/8-inch round steel holders, such as shown in Fig. 9, in which illustration they appear slightly over-size. These holders are usually mounted in a common flat bar which has a hole bored straight into the front end to receive the holder. Diamonds of the kind used are of a laminated structure, the boundary of each layer being known as a "cleavage plane." The diamond worker must study each diamond carefully to determine the location of the cleavage planes, and then split the diamond "along the grain." Diamonds differ considerably in this respect and must be treated individually. When placed in the holder, a diamond must be set properly in relation to the cleavage planes, because later, in grinding the diamond to obtain a cutting edge, it is ground along the selected cleavage plane, the same as a wooden board is planed along the grain.

Preparatory to setting a diamond, a hole of about the diameter of the diamond is drilled in one end of the holder, and eight fine slots are cut radially from this hole with a hacksaw. The diamond is then inserted in the hole, and the slotted sections of metal are squeezed and clamped securely against the diamond to hold it in place during the next operation, which consists of brazing the diamond in the holder. After this, the excess brass and part of the metal at the end of the holder in which the diamond is inserted, are ground away.

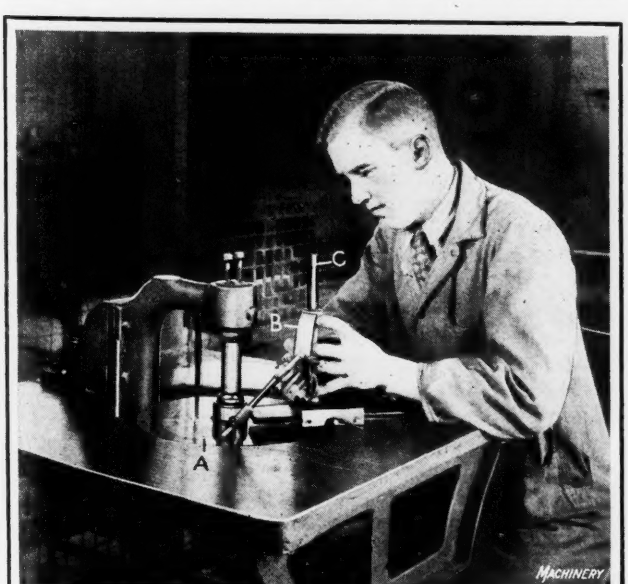


Fig. 10. Grinding a Cutting Edge on a Diamond by moving it back and forth slightly over a Rapidly Revolving Lap

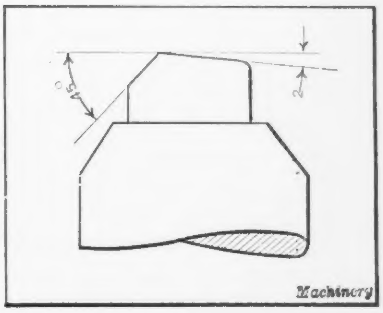


Fig. 11. Outline to which Diamonds are ground for Turning Operations

How the Diamonds are Ground

Diamonds can be ground for outside turning, boring, radius turning, facing, and, in fact, for almost any lathe operation for which high-speed steel tools are suited. Pointed tools are ground to various included angles between 60 and 120 degrees. Turning tools are usually ground to a 45-degree angle at the left-hand end of the cutting edge, as shown in Fig. 11, the width of the bevel depending upon the depth of cut to be taken with the tool. The wide front portion of the cutting edge is ground at an angle of 2 degrees from the bevel, and a clearance of 2 degrees is ground on the front face of the diamond when the tool is to be used for cutting brass and aluminum. For cutting cast iron, this clearance angle amounts to 5 degrees. All types of tools, whether intended for turning, boring, facing, etc., are given the same amount of clearance. The top surface of all diamonds is ground flat.

The diamond in holder *A*, Fig. 9, is ground for outside turning; the diamond in holder *B*, for radius turning; the diamond in holder *C*, for turning and facing shoulders, and similar operations; and the diamond in holder *D*, for necking. A boring diamond would be ground the same as the diamond in holder *A*, with the exception that the 45-degree bevel would be on the opposite side.

Diamonds are ground on the machine illustrated in Fig. 10, which consists essentially of a rapidly revolving lapping disk *A* and a holder *B* by means of which the diamond can be reciprocated slightly at the proper angles over the disk. The disk is an iron casting into which diamond dust is charged. It is run at about 1600 revolutions per minute. Holder *B* can be conveniently slipped on and off the vertical post *C* about which it is swiveled by hand. Post *C* is fastened to a block which may be clamped in various positions along the dovetailed vee.

The holder is adjustable in two directions so as to obtain the desired angle of grinding, and each adjusting device is provided with a graduated member to facilitate the settings. During the grinding, the diamond is moved back and forth about 1/2 inch on the disk, and only sufficient oil is used to keep the lap moist. The operation is carried on until the diamond has been given an edge that is clean and sharp when observed under a magnifying glass. The lapping disk can be used continuously for about four months before recharging is necessary. The disk is then reground to remove all grooves, and charged with diamond dust as before.

* * *

NEW INDUSTRIAL MARKETING JOURNAL

The first issue of a new journal in the distribution, advertising, and sales fields will appear January 1. The journal, published by G. D. Crain, Jr., of Chicago, Ill., publisher of *Class* and of Crain's Market Data Book and Directory of Class, Trade and Technical Publications, will be known as *Industrial Marketing*, and will cover distribution methods, sales organization plans, news of industrial markets, and the application of advertising to the development of industrial sales.

What MACHINERY'S Readers Think

on Subjects of General Interest in the Mechanical Field

COOPERATIVE INDUSTRIAL EDUCATION

Mr. Falk's paper on the need for a national apprentice system read at the New Haven meeting of the Shop Practice Division of the American Society of Mechanical Engineers, and published in September MACHINERY, deals with a subject of greater importance to our national life than many of the problems so elaborately discussed by national leaders. The foundation of a nation with high standards of living—a nation successful in industrial and commercial enterprises—rests largely upon the education and training that the younger generation receives.

We have built up an elaborate system of theoretical education. Taken as a whole, it is doubtful if our schools are equalled anywhere in the world, but we have sadly neglected the fact, especially important to an industrial nation like ours, that training in a specific vocation or life work is just as important as teaching a child to read and write. We have left it entirely to the individual's own initiative or judgment as to whether or not he will fit himself to take his proper place in our industrial and commercial life. If he chooses to be completely untrained in the art of working—and some form of work should be considered the fundamental duty of every individual—he is entirely at liberty to do so. He can grow up and live all his life in a civilized community as an "illiterate" in the useful work of the nation. This, I believe is the most important problem confronting not only our industries, but the nation as a whole.

A national apprenticeship would go a long way toward solving this problem. It may also be that our educational system should be extended to include, in every case, the cooperative high-school idea that has been so successfully applied in many cities—notably, Springfield, Vt., Beverly, Mass., and Fitchburg, Mass. Furthermore, instead of making it a matter of choice as to whether or not a boy should take such a cooperative course, where he spends half the time in the schoolroom and half the time at actual work, I believe that this method of education should be made compulsory for every boy, whatever his station in life. After he has been taught to perform some useful work with head and hand, he can then turn to whatever field of education or profession he chooses. His background will be far more satisfactory and he will have a real education to build on, instead of a number of unrelated facts absorbed from books.

I believe that it is just as important to make it compulsory for a young person to learn a useful trade or occupation as it is to make it compulsory for him to learn to read and write. M. R.

OBSOLETE ANNEALING METHODS

There are still some firms that use the old method of pack annealing, which gives good results as far as producing a soft metal is concerned, but which is inefficient from an economical and engineering point of view.

When this method is used, a layer of iron borings, about 1 1/2 inches thick, is placed in the bottom of a heavy box, and then as many parts as possible are placed on the borings and the top covered with another thick layer of borings. The lid is next placed in position and luted with fire-clay, after which the box and its contents are heated, which takes from four to five hours. After soaking for some time, the furnace is allowed to cool over night. The annealed parts are then removed. The objections to this method are as follows:

1. The weight of the parts to be annealed is only a fraction of the weight of the box and borings, and hence, only a portion of the heat supplied to the furnace is used for heating the actual parts to be annealed. In one case, the weight of the box was 150 pounds and the weight when packed with parts varied from 200 to 700 pounds. The packing constituted from 25 to 50 per cent of the material in the box. In the worst case, then, 175 pounds represented the weight of the box and packing and 25 pounds the weight of the actual parts. Neglecting any differences in the specific heat of the materials, which would be very small, only 12 1/2 per cent of the heat supplied was actually used for annealing. This is an extreme case, but the loss is always great. A furnace that would take three of the boxes mentioned consumes 1200 cubic feet of gas per hour. Obviously, this method of annealing is expensive.

2. The object of the packing is to keep out the air and to retain sufficient heat to cause the material to cool slowly. You cannot, however, exclude oxygen effectively by such means, and in practice, the parts oxidize to a considerable extent. When the boxes are new, scaling can be reduced to a minimum, because the luting can be done effectively. Continued exposure to high temperatures, however, causes even the strongest and most durable boxes to warp, and effective luting becomes impossible. After annealing, the scale must be removed, usually by tumbling—an additional expense. When pressed parts are annealed between successive drawing operations, any oxide film on them is bad for the press tools. It is not always possible to make the insides of these shells perfectly clean even after continued tumbling.

3. It takes time to pack boxes. Some parts pack easily, while others, due to their shape, cannot be properly packed. This is the reason for variation in the total weight of packed boxes relative to material being annealed.

4. The cost of good packing boxes increases the cost of the operation, as even the best boxes have to be renewed quite often.

The writer considers pack annealing an obsolete method. It slows up output and increases the cost of maintaining press tools. There are a number of good closed annealing furnaces that will do the work in half the time and at 25 per cent of the cost. The annealing plant is often neglected. Frequently it is in a room away from the main shop, and those in charge give little thought to it. Obsolete annealing equipment may, however, waste more money than a battery of obsolete machines. BERNARD BROWN

WHY THE MACHINE TOOL USER NEEDS SERVICE

Some years ago Dean Kimball, of the Engineering College of Cornell University, in speaking before the National Machine Tool Builders' Association, coined the expression "Master tools of industry." In this connection, he pointed out that the tendency of our whole industrial era is to transfer the skill of individual workers to machines, so that the machines will perform equally well, or better, and much faster, the work that formerly could be done only by employing the long experience and skill of a trained workman. This "transfer of skill"—as this modern industrial tendency has been termed—is the basis of all quantity production.

There is also another tendency that is producing a great change in our industrial methods. Not only has skill been transferred from the worker to the machine, but it has also been transferred from the machine user's plant to that of the builder. Years ago, a machine tool manufacturer, after he had sold a machine, heard nothing further about it. It went into a plant where it was used by mechanics of practically the same skill as those who had built it. These men knew

how to care for the machine properly, and if something went wrong, they knew how to repair it.

Today conditions have changed, and with the new conditions has come the demand for service—that is, the builder of machine tools is required to instruct and train operators in the user's plant and to keep the machines in operating condition. The machines are more complicated, and when they are placed in the large production plants of today, they are no longer handled by all-around skilled mechanics, but are placed in the hands of men who know little or nothing about the machines that they use, except to manipulate certain levers and handwheels that control the motion of the work and the cutting tools.

If something goes wrong, these men are seldom able to repair the damage—and unfortunately, things go wrong much oftener than in the past, because the unskilled operator has no appreciation of the care required by so intricate a mechanism as a semi-automatic or an automatic machine. The skill necessary in order to discover the causes of operating troubles and make repairs must often come from the shop of the builder of the machine. It has been "transferred" from the user's shop to the builder's.

It is well to recognize that, in addition to the demonstrator's work in training operators to handle new and complicated machines, this is one of the main causes of present-day demands for service in the machine tool field. While considered excessive by many, it is not likely that the demands for service will ever become less. On the contrary, it is likely that the machine tool builder's plant must furnish more and more of the skill required to keep the equipment that he has built in operating condition.

Recognizing this tendency of the times, the progressive machine tool builder so organizes his business that he is in a position to render this service. What is needed, in addition, is some systematic method of charging for this service, because unless the price of the machine is high enough to provide for the cost of such service, it must by necessity be charged for separately. It is impossible for the machine tool builder to give it for nothing, and the buyer, being relieved of the necessity of maintaining in his own plant all the skilled men required to train operators in the use of new and complicated machines and to keep the equipment in operating condition, should not object to paying for service that is part of his operating expense. OBSERVER

STANDARD VERSUS MADE-TO-ORDER MACHINERY

With an ever-increasing number of manufacturers adopting the principles of standardization, many machinery users will find it difficult to have their own ideas incorporated in new equipment. In years past, manufacturers would gladly take orders for machinery that included certain special features. These deviations from the regular product usually added materially to the cost, but the sales price was not increased in proportion. This apparent loss was spread over other orders for regular machines, and thus absorbed. Modern cost-accounting shows that this idea is wrong, and that the additional cost should be borne by the customer of the special equipment.

Along with improved cost-finding systems, comes a universal response to Herbert Hoover's appeal for simplification and standardization. Readers of technical journals and government reports are familiar with the results already accomplished in many lines. The principle of standardization is not involved or difficult to apply. It is the selection of as few of the best varieties as possible, and the concentration on these as standards. This naturally leads to mass production—the ideal condition for low manufacturing costs.

We now come to the customer who is accustomed to buying machines with his own special features included. When he makes inquiries about new equipment, he is shown standard products. These may be composed of lines of bases with certain definite equipment which may be mounted on each type of base to make up a complete machine. The equipment is standard and has a regular price, including assembly cost. The various standard equipments must, of course, be carefully designed to avoid complication and also to adequately cover the field for which the machine is intended.

When a customer insists on having special features included, an estimate should be made of the additional cost. This amount should be added to the regular selling price, and the total given as the quotation for that particular machine. The difference is easily sufficient to cause reconsideration of the requirements, and in the majority of cases, the standard equipment can be sold.

When the principles of standardization are applied in the design of parts, both the manufacturer and the consumer are benefited. A manufacturer can carry a smaller stock of both raw material and finished parts, because of the reduction in the variety. He also finds that not nearly so many special tools are required as under the old plan. These savings are an addition to those made by having the work done in larger lots and by using better tools and fixtures, as made possible by quantity production methods.

The customer profits by being able to secure repair parts from stock on short notice and at a lower price. He can also buy one of the different equipments or parts available, and in this way change over his machine at a minimum expense. It is not at all surprising that standardization is being adopted in so many different lines when both the machine maker and the user are benefited thereby.

LAWRENCE F. SWENSON

BONUS SYSTEMS OF WAGE PAYMENT

The writer agrees fully with Mr. Gray, the author of the article "Wage Payment and Bonus Systems" in September MACHINERY, page 30. When there is no incentive in the form of a bonus for the worker to put forth increased effort, the only way to get results is through the efforts of the foremen who inspire the workers to produce a fair day's work. Men may exert themselves for a time, but if there is no increase in remuneration forthcoming, there is no incentive to maintain a high rate of production.

In the case of office workers, where promotions to better-paying positions are more likely to follow the putting forth of unusual effort, a bonus system of payment is not as necessary as in the shop. A possible promotion to a position with better pay is in itself an incentive. The majority of shop men, however, cannot look forward to promotions, nor to more than small increases in their hourly pay; hence, an incentive in the form of a bonus for productive effort above a certain minimum is the only incentive that can be expected to have a very definite meaning in the shop.

It is unfortunate that the average working man seems to believe that there is just so much work in the world to be performed and that the sooner he finishes this work, the sooner he will be out of a job. When he realizes that the more he produces, the cheaper will be the product, and hence the greater the demand, he will understand that his job depends not upon turning out a limited amount of work, but upon producing efficiently. In no industry is the production per worker greater than in the automobile industry, and because of this great production, the price of automobiles has been brought down until the demand exceeds all expectations.

If the workers in the automobile plants of fifteen years ago could have controlled their own productivity, they might have been inclined to work slowly enough so as to keep themselves employed the year around, building very expensive cars. If they had been successful in this, they would have kept the price of cars up to a level where the demand today would have been but slightly above the demand of fifteen years ago, and instead of more than half a million people being engaged in the building and maintenance of automobiles, we would have employment for only a few thousand in that industry. ENGINEER

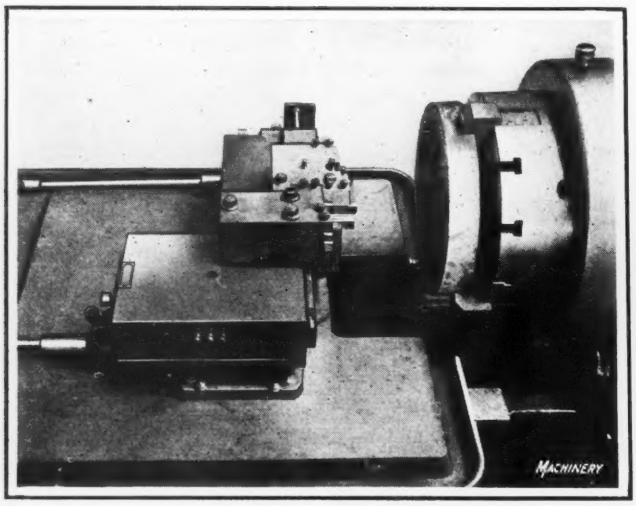


Fig. 1. Set-up of the Machine employed in the First Roughing Operation on Studebaker Flywheels

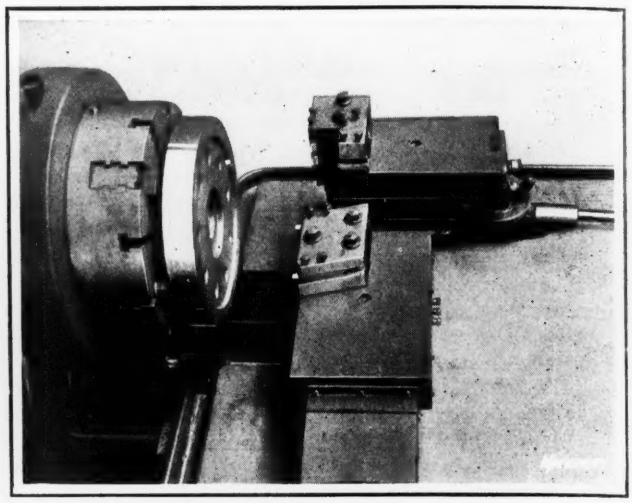


Fig. 2. Arrangement of the Tooling provided for the Fourth and Final "Simplimatic" Operation

Machining Studebaker Flywheels

FOUR separate operations, two of them roughing and two finishing, are performed on Studebaker flywheels to machine them all over from the rough. These flywheels are iron castings of the dimensions given in the sectional drawing, Fig. 5. The four operations are performed on "Simplimatics," built by the Gisholt Machine Co., Madison, Wis., which are equipped with the tooling shown in the accompanying lay-outs. Fig. 1 illustrates the first operation, and Fig. 2, the second finishing operation. Three-jaw air chucks are provided on the four machines, the work being gripped on the periphery in the first roughing and first finishing operations, and on the inside of the rim in the second roughing and second finishing operations. In the following description, the capital reference letters designate the various surfaces of the flywheel as given in Fig. 5, and the small letters refer to the various tools in the tooling lay-outs.

As may be seen in Fig. 3, the rear tool-slide is fed longitudinally toward the left in the first roughing operation, and the front tool-slide is fed transversely toward the front of the machine. In the movement of the rear tool-slide, surface *A*, Fig. 5, is turned by tool *a*, Fig. 3, and hole *B* is bored by tool *b*. At the same time that these cuts are taken, surface *C* is faced by tool *c*; surfaces *D* and *E*, by tool *d*; and surface *F* by tool *f*. Tools *c*, *d*, and *f* are mounted on the front slide. In order to give tool *d* the necessary sidewise movement to permit facing both surfaces *D* and *E*, the tool is held in a block that is automatically shifted to suit the surfaces as a roller attached to the block travels in cam slot *x* of a member beneath the tool-block.

Second Roughing Operation

In the second roughing operation, the work is mounted in the reverse position, and the machine used is fitted with two tool-slides operating in the same direction as those in the preceding operation. Referring to Fig. 4, it will be seen that as the rear slide is fed toward the left, periphery *G* is turned

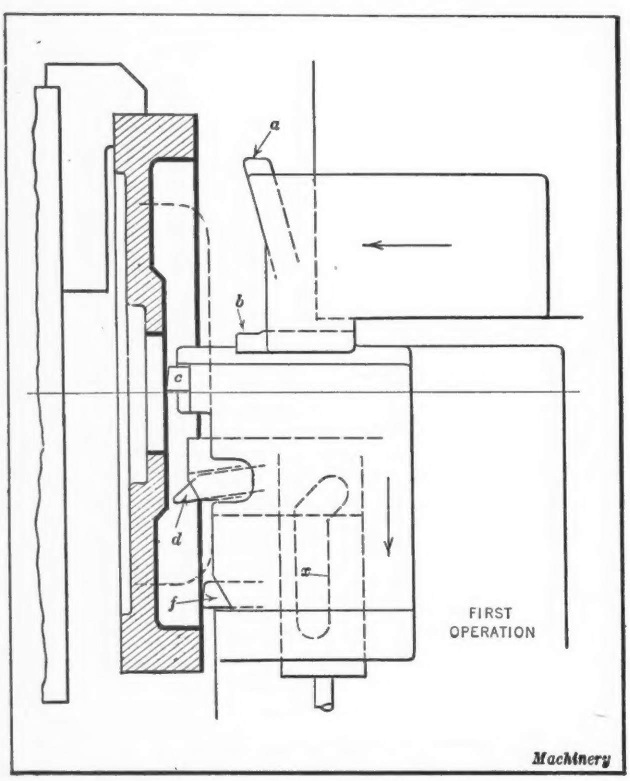


Fig. 3. Diagrammatic Lay-out of the Tooling Equipment provided on the Machine illustrated in Fig. 1

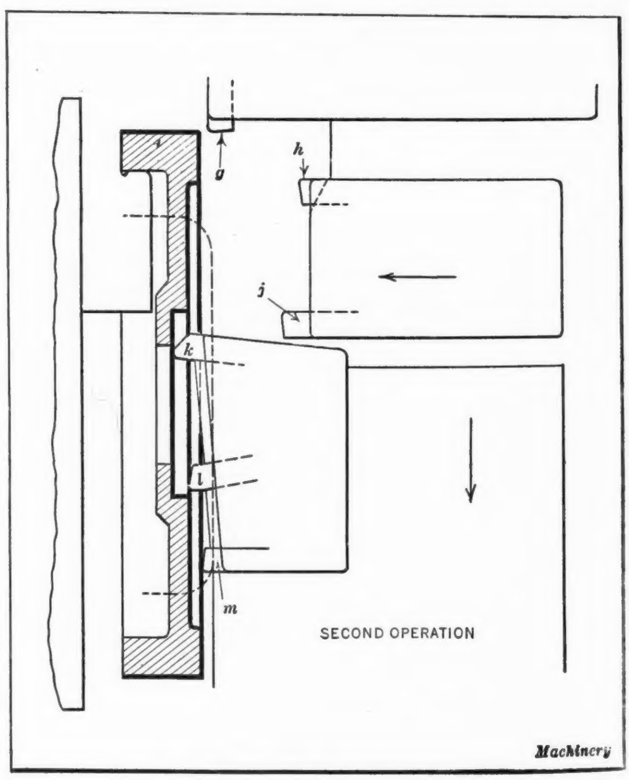


Fig. 4. Lay-out of the Tooling Equipment furnished on the Machine used in the Second Roughing Operation

by tool g; surface H by tool h; and surface J by tool j. At the same time, as the front slide advances toward the front of the machine, surface K is faced by tool k; surface L by tool l; and surface M by tool m.

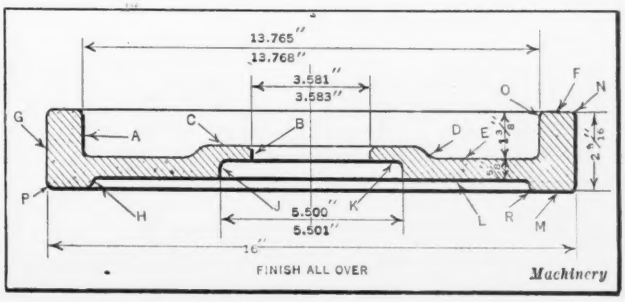


Fig. 5. Sectional Dimensioned Drawing of the Flywheel

First Finishing Operation

The first finishing operation is performed in a "Simplimatic" equipped with the tooling shown in Fig. 6. As the rear tool-slide of this machine is fed toward the headstock, corner N of the flywheel is rounded by tool n; surface A is turned by tool a; corner O is rounded by tool o; surface D is finished by tool d; and hole B is bored by tool b and chamfered at one end by tool q. Tools b and q are mounted on a substantial bar which is piloted in the machine spindle at the forward end to adequately support the tools during the cuts, and thus insure that the hole will be bored concentric with the other circular surfaces of the flywheel.

When the front tool-slide is advanced toward the front of the machine, surface C is faced by tool c; surface E by tool e; and surface F by tool f. At the beginning of the movement of the front tool-slide, tool e must be shifted toward the left into line with surface E. This has been provided for by mounting the tool in a block which is automatically shifted to the left independently of the other tools on the same slide, through the action of a roller attached to the block which engages a cam slot x in the member on which the block rests. The arrangement is similar to that provided in the tooling equipment illustrated in Fig. 3.

Second Finishing Operation

Fig. 7 shows the lay-out of the tooling employed in the second finishing and final "Simplimatic" operation. As the rear tool-slide of this equipment is fed toward the headstock, surface G is turned by tool g; corner P is rounded by tool p; and corner R is rounded by tool r. With the forward advance of the front tool-slide, surface L is faced by tool l, and surface M by tool m. The four machines described in this article completely machine flywheels from the rough in an average floor-to-floor time of four minutes.

ANNUAL MEETING OF THE A. S. M. E.

At the annual meeting of the American Society of Mechanical Engineers to be held December 6 to 9 at the Engineering Societies Building, 29 W. 39th St., New York City, sessions will be held relating to machine shop practice, materials handling, fuels, industrial power, textiles, wood industries, railroads, heat transmission, central power stations, management, aeronautics, oil and gas power, petroleum, and springs.

The machine shop practice sessions will be held on Wednesday morning, December 8, at 9:30 A. M., and on Thursday morning, December 9, at the same hour. The following papers have been announced for these two sessions: "A Research in the Elements of Metal Cutting," by Orlan W. Boston; "Work-hardening Properties of Metals," by Edward G. Herbert; "Rough-turning with Particular Reference to the Steel Cut," by H. J. French and T. G. Digges; "Theory of Milling Cutters," by N. W. Sawin; and "Chromium Plating," by William Blum. The materials handling session will be held Wednesday morning, December 8, simultaneously with the machine shop practice session.

* * *

MECHANICAL FEEDS IN COLD-FINISHING OF METALS

In a paper on "The Cold-finishing of Metals," read by E. V. Crane of the E. W. Bliss Co., Brooklyn, N. Y., at a technical session of the New Haven Machine Tool Exhibition, New Haven, Conn., September 7 to 10, the author pointed out that the advantage of the mechanical feeds adaptable to presses used for cold-finishing of metals is that these feeds place the work accurately under the slide, catching every stroke of the continuously operating press, relieving the operator of considerable fatigue and of nervous strain from the danger of getting his fingers caught. Those mechanical feeds which may be used to advantage in different cases include the simple magazine feeds, known also as coin feeds or push feeds, and station dial feeds, chain feeds, friction dial feeds, and occasionally hopper feeds.

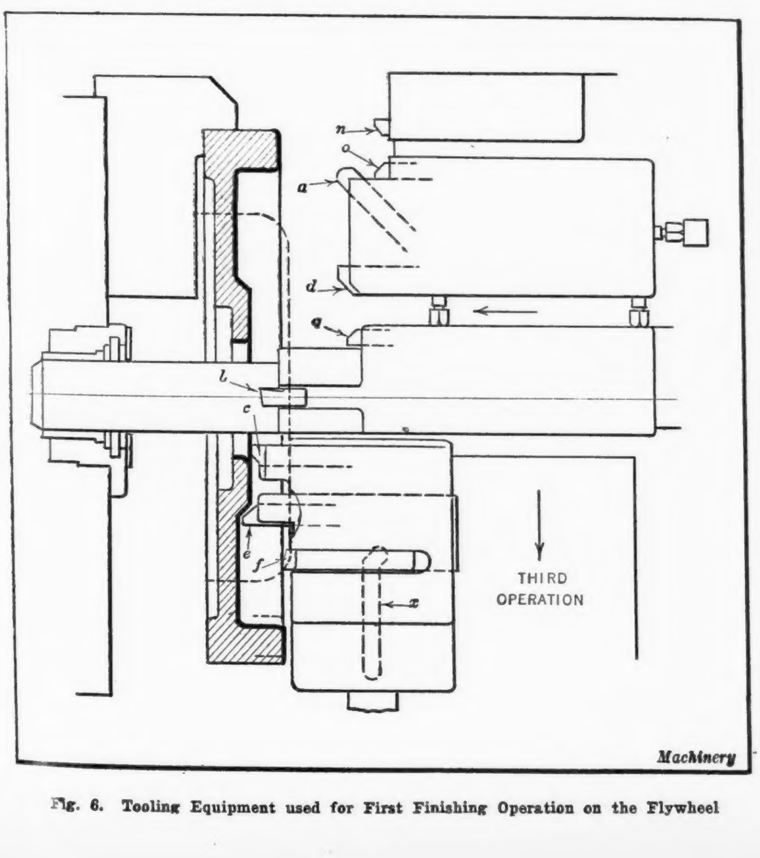


Fig. 6. Tooling Equipment used for First Finishing Operation on the Flywheel

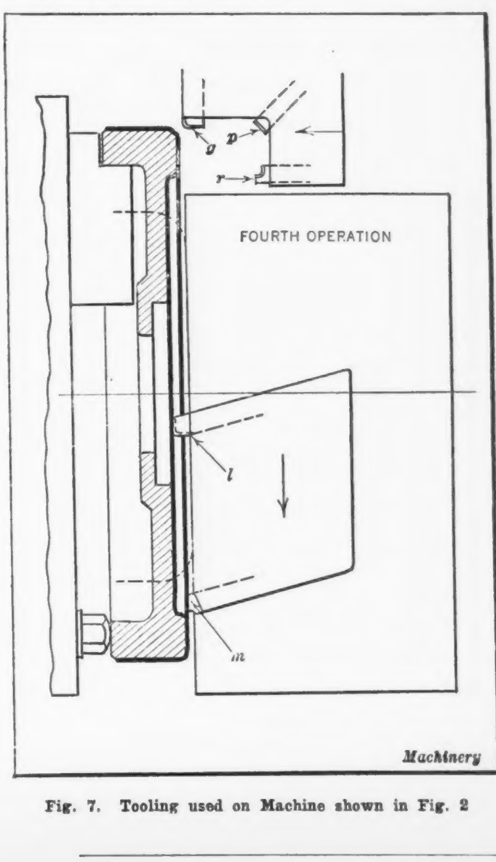


Fig. 7. Tooling used on Machine shown in Fig. 2

Points on Jig and Fixture Design

By C. C. HERMANN

JIG and fixture design has two principal objects—the reduction of manufacturing costs and greater accuracy. Without a drill jig, for example, it would be necessary to lay out, from a drawing or blueprint, each hole required in a part. This would make it practically impossible for unskilled workmen to produce an accurate piece of work. In fact, highly skilled mechanics would be needed to produce results comparable with those obtained by ordinary untrained workmen using properly designed jigs. Essentially, therefore, a jig is a device designed for the purpose of efficiently duplicating accurate work on parts produced in quantities.

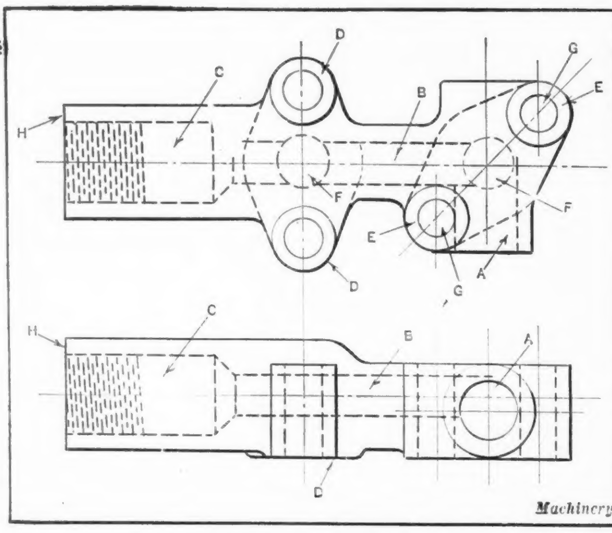


Fig. 1. Body of Relief Valve for which Jigs shown in Figs. 2, 3, and 4 were designed

The foregoing requirements are incorporated in a jig by making use of various elements of approved design, which are employed in combination with new devices, such as may be required by the shape of the piece and the nature of the work to be accomplished. Care must be taken, however, to see that speed is not obtained at the expense of accuracy by new and untried devices.

Finish on Jigs

Broadly speaking, the constructional features of the jig depend upon the character of the work in hand. There are certain general points, however, which may well be considered before studying specific examples. The first of these has to do with the finish given the machined surfaces. The finish given a jig is generally determined by the established practice in the shop where it is made. In many shops, the only requirement is that the finish shall be such as to prevent lint from clinging to the jig when the surfaces are wiped with machine waste. In other shops, a finish is required which does not show tool marks. Another requirement of importance is that there shall not be any rough surfaces on the jig that will come in contact with the operator's hands. Square corners should be eliminated, especially on movable members, such as clamps, hinged drill bushing plates, and parts that must be grasped by the operator. If these seemingly trivial matters are neglected, production will be materially reduced.

All jigs and fixtures should be so designed that they can be easily kept clean. Metal chips or dirt, if allowed to collect in the joints or crevices beneath the work or behind a ledge, may hold the work away from a stop or a bearing surface, thus causing inaccuracy or spoiled pieces. Instead of long continuous bearing surfaces, it is advisable to provide several comparatively small seats for the work to rest upon, with clearance for the work between the seats.

In locating the bearing surface, the spring of the work must be taken into consideration. Inaccuracy may result from having the bearing surface too far from the point at which the drilling or machining pressure is applied. This results in the work being sprung and distorted from its normal position. Fastening devices should also be located whenever it is possible, over bearing points in order to avoid springing the work when it is tightly clamped in the jig or fixture.

Planning Sequence of Operations

When several jigs are required for the production of a piece, care should be taken to design them for use in the proper sequence. The first step, then, in jig design is to plan the order in which the various operations are to be performed. Take, for example, the part shown in Fig. 1, which is the body of a relief valve. The operations required to produce this piece are: Drill the hole *A* which intersects the drilled hole *B*; enlarge hole *B* at *C*, and thread, as indicated in the illustration; ream the cavity beyond the thread accurately to size, or to fit the plunger which is to be assembled with the piece; finish the flanges *D* and *E* and drill the holes *F* to intersect the chamber *B*; also drill holes *G* to receive the bolts that pass through the corresponding flanges in a matching piece; and, finally, spot-face the end *H*.

In machining this part, it is obvious that a milling operation must be performed on the flanges, a spot-facing operation on the end *H*, nine drilling operations, one reaming operation, and one tapping operation.

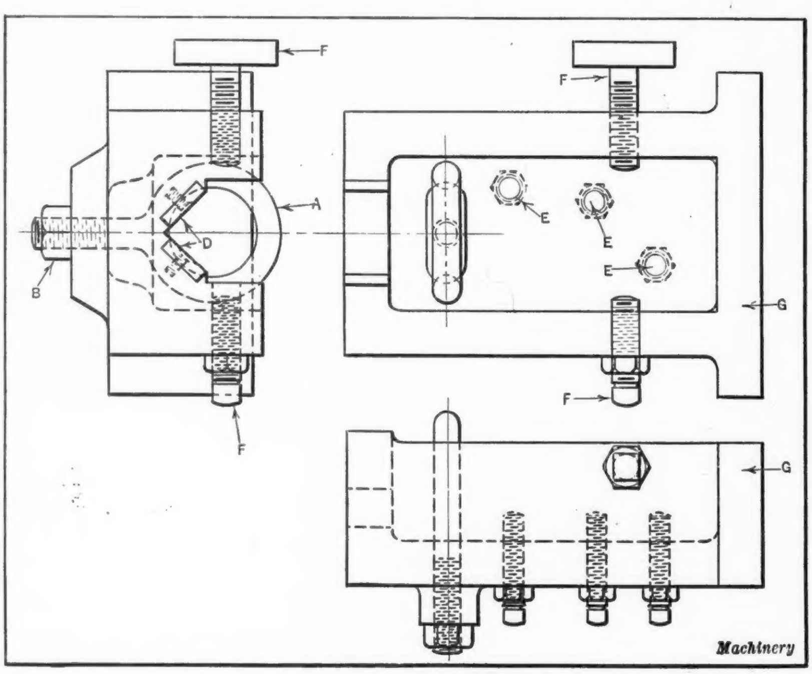


Fig. 2. Fixture used when milling Flanges D and E, Fig. 1

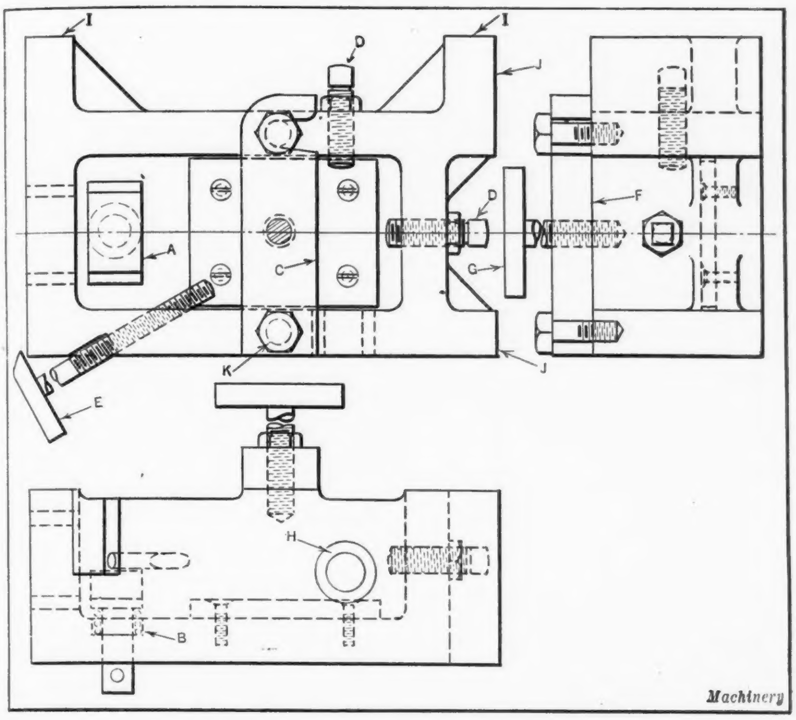


Fig. 3. Drill Jig employed for Second Operation on Relief Valve Body

The problem now becomes one of determining in what order these operations must be performed. Examination of the piece shows that practically all holes must be located from their common base, which is the machined surface of the flanges.

The first operation is, therefore, that of milling these flanges. The second operation is drilling the flanges, including the drilling of the center holes *F*, or the holes *A*, *B*, and *C* can be drilled, after which the required reaming and tapping operations may be performed. As hole *G* is located close to hole *A* with only a very thin wall between, the larger hole *A* should be drilled first. The reason for this is that, should the holes in the flanges be drilled first, there would be danger of the larger drill breaking out the thin wall of metal, and thus spoiling the casting.

The sequence of operations, therefore, would be arranged as follows: First, mill the flanges; second, drill holes *A*, *C*, and *B*, and ream and tap the upper portion of hole *C*; third, drill the flanges. It will be noted that the drilling and tapping operations, exclusive of hole *A*, are performed in the following order: First, drill hole *C*, next drill hole *B*, and then ream and tap hole *C*.

Milling Fixture

In Fig. 2, is shown the fixture for holding the work while milling the flanges. The work is placed in the fixture with the cylindrical end inserted in the eye-bolt *A*. The eye-bolt is then drawn down by the nut *B* until the end of the cylindrical portion rests in the V-notch machined in the end wall of the fixture, which is provided with hardened supporting plates *D*. The adjusting screws *E*, which have hardened points, support the part by bearing against the flange bosses. The adjusting screws *F*, one of which is in the form of a handwheel, and the other a set adjustment, are also used to cramp the work in place. During the milling operation, the work rests on the end *G* of the fixture, which, in turn, rests on the machine table.

There is some objection to using set-screws for locating the work in a jig or fixture, hardened steel inserts in the casting being preferred in many shops. Machined bosses are used quite often, however, in cases where the total number of pieces likely to be produced is small. For larger quantities of work, where there is considerable wear, the bosses must be trued up by machining at regular intervals. Of course, the bosses may be drilled and tapped for adjusting screws at any time. The writer, however, has always recommended using the three-point bearing method, with adjustable-contact screws.

Drill Jig for Second Operation

In Fig. 3, is shown the drill jig employed for the second operation, which is performed after the flanges have been milled. For this operation, a hardened V-block *A* is used to locate the work. This block is supported by a spring *B*, which tends to hold it in contact with the work and yet allow the work to rest firmly against the hardened inserts *C* on the bottom of the fixture. The set-screws *D*, which have hardened points, locate the rear end of the work, and the hand clamp *E* serves to force the work back against the hardened points of the screws. Clamp *F* and screw *G* are also employed to hold the work in place. Clamp *F* can be swung around on the stud *K* to allow the work to be placed in the jig.

The hole *A*, Fig. 1, is drilled first, using the bushing *H*, Fig. 3. For this operation, the jig is placed on its side, with the feet *I* in contact with the milling machine table. When drilling the hole in the end of the work, the jig rests on the end feet *J*. The operations in the end of the work comprise drilling two different sized holes, reaming the larger hole, and tapping it for about one-half its depth. This requires a slip bushing for each different size of tool.

In addition to these operations, the end of the work is spot-faced, using a tool which passes through the hole in the jig provided for the drilling operations. For the spot-facing operation, all the bushings are removed and the bushing hole liner serves as a guide for the tool. After the spot-facing operation, the hole *C*, Fig. 1, is drilled, employing a slip bushing of the correct size. The hole *B* is then drilled, using a guide bushing which is slipped into the larger bushing used in drilling hole *C*. Following these drilling operations, hole *C* is reamed, a reamer guiding bushing being substituted for the drill bushings.

The third and last operation on the piece is that of drilling the flange holes and the hole in the center of each flange. The jig for this operation is shown in Fig. 4. This jig is

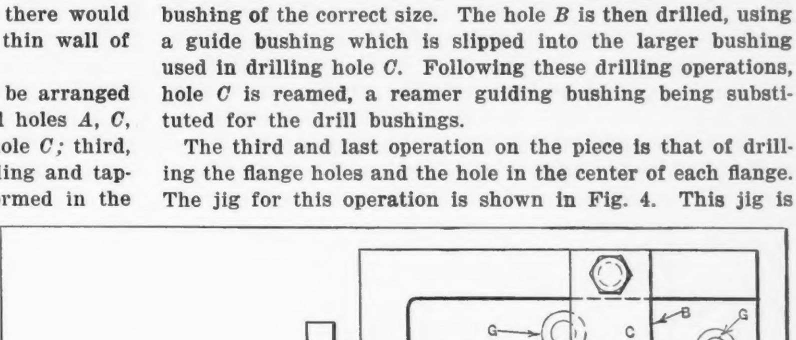


Fig. 4. Jig used in drilling Holes in Flanges

constructed with an open end at A, permitting the work to be readily inserted in the fixture under the cross-bar B which carries the clamping screw C. Before the clamping screw is tightened, however, the workman must make sure that the piece is drawn up tightly against the machined end. This is accomplished by having the threaded end D of the handwheel E enter the tapped hole in the end of the work. As in the previous drilling operation, the work is located on hardened inserts. The drilling operations are performed with the jig resting on the feet F. The six drill bushings are indicated by the reference letters G. In designing the jigs described in the foregoing, care was taken to use the surfaces machined first, for locating points in subsequent operations.

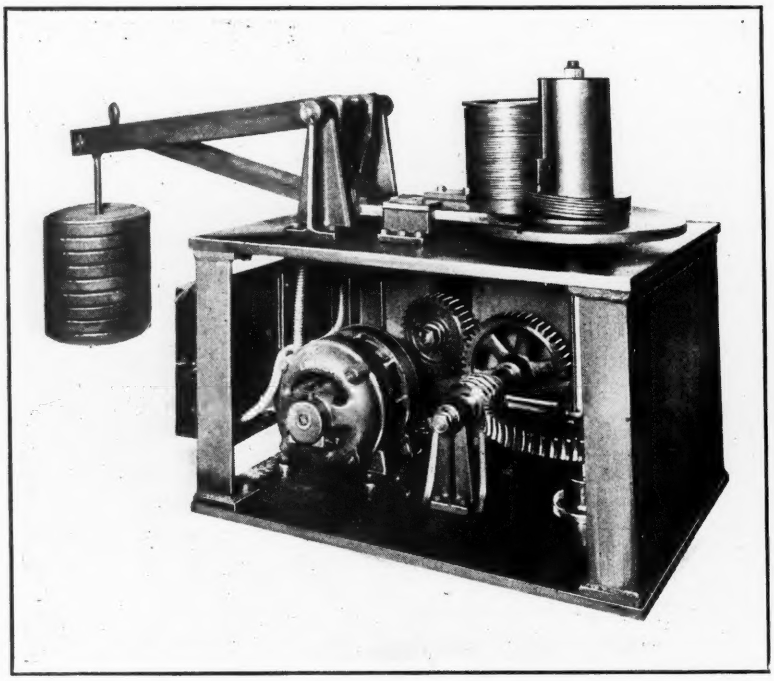
* * *

SPECIAL MACHINERY BUILT FROM WELDED STEEL

By FRANK ROUGE, Tool-room Foreman, Lincoln Electric Co., Cleveland, Ohio

The cost of building special machines in the tool-room often runs far higher than is estimated. The cost department cannot avoid charging all the patterns used, against the special machine, since the pattern is used only once and is scrap, for all practical purposes, after the machine is built.

Owing to the large number of special machines used in the manufacture of Lincoln motors and arc welders, we have found it advantageous to use welded steel frames and bases for such machines in place of gray iron castings. Most special machines can be simplified, so that standard plate and structural steel sections can be welded together to produce the desired result. In this way we are able to use raw material from stock or from local steel warehouses.



Machine for winding Copper Bar Stock built from Welded Steel

Elimination of the pattern cost results in a substantial saving. In many cases we are able to make the welded steel piece for one third of the pattern cost. Owing to the greater strength of steel, as compared with cast iron, there is a considerable saving in weight. This is important, since steel costs only three cents per pound, cut to size, against about eight cents per pound for the rough casting. The welding cost is a small item—usually not more than half a cent a pound on the welded steel piece if the piece weighs over 150 pounds. On the average, we save, by the use of welded steel, two thirds of the pattern cost and over half of the material cost.

In the accompanying illustration is shown a special machine for winding heavy bar copper stock used as end rings for our "Linc-Weld" motors. The frame of this machine is of welded steel, and, as will be seen, the construction is quite simple, the top and bottom consisting of steel plates with ordinary structural steel angles for corner posts. The estimated pattern cost on a typical design to be made of cast iron amounted to $140. Our cost on the welded frame complete, ready to machine, was $31.85. A gray iron casting frame of equivalent strength would have weighed 3900 pounds and cost $312 ready to machine. The tool-room checked in with a saving of $420.15 on this machine by using a welded steel frame. An additional saving was made on the weighted arm, which illustrates a typical example of welded steel construction. The cast-iron brackets were in stock and were therefore used in place of welded steel for these parts.

The use of welded steel construction by the tool-room for special machinery and for other purposes where it shows substantial economies, involves a considerable amount of cooperation on the part of other departments in the plant. The tool design section must design the job for welded steel if it is to be a success and the estimated savings realized. The welded design should originate in the engineering department when the tool lay-out is made for the job. In this way the short cuts and savings are included in the cost estimate and the job goes through the tool-room as scheduled. Additional short cuts are promptly approved by the design section without lengthy discussion.

* * *

STEEL TREATERS' EXHIBITION IN 1927

The American Society for Steel Treating announces that its ninth annual convention and exposition will be held in Convention Hall, Detroit, Mich., September 19 to 23, 1927. Convention Hall is located midway between the Statler Hotel and the General Motors Building in Detroit, and has an even greater exhibit area than the Municipal Pier in Chicago, where the exposition was held this year, and which, although large, was not sufficient to accommodate all exhibitors desiring space. Space assignments will be made for the 1927 exhibit after the floor plans and contracts have been forwarded to all of the Chicago Show exhibitors, about January 15, 1927.

The society requests that any exhibitors at the Chicago Show who desire to relinquish their option on preferred location for the 1927 exposition in Detroit, give notice to that effect as soon as possible, so that those on the waiting list may be advanced and assured of space at Detroit.

* * *

The new immigration law has materially curtailed the supply of unskilled labor in the United States. The figures for the fiscal year 1925-1926 show that the supply of unskilled labor increased, through immigration, by but slightly more than 10,000—this being the number of laborers who came into the United States in excess of the number that returned to their home country. In connection with this, it has also been pointed out that the criticism that the immigrant returns to his native land, taking a great deal of money out of the country, or that he sends back large sums of money, is based on but a slight appreciation of the facts. The amounts that are thus transferred to foreign countries are extremely insignificant compared with the $4,000,000,000 that American investors placed abroad in foreign and domestic securities during as brief a period as the first six months of this year. Of a total of about $2,875,000,000 invested in corporate securities during the first half of this year by American investors, approximately $1,225,000,000 went abroad.

Methods of Holding Tools and Cutters

First of a Series of Articles

By FRED HORNER

THE design of a cutting tool and the means for clamping and adjusting it are subjects of great importance to the tool designer and toolmaker, as well as to the tool setter and machine operator. In the ordinary machine shop, a great variety of methods are employed to hold and adjust the tools and cutters, and in nearly all cases, the requirements are very exacting. Any tool-holding means that will permit movement or slippage of the tool cannot be tolerated, especially for high-grade work, where a large number of interdependent tools are used and long runs on repetition work are made.

In addition to the many devices for holding and adjusting the tools, which are incorporated in the design of the machine, there is a multiplicity of special methods of joining and adjusting the tools themselves. The difficulties met with in designing cutter and tool equipment are many and varied, especially when tools must operate in a limited space. Simplicity, strength, and durability are generally desirable, although some tools, such as those employed for finishing operations and for fine precision work, necessarily possess some degree of delicacy.

Tool Clamp Requirements

In fastening a tool, or the shank of a tool-holder, to the machine, two important points must be considered, namely, the securing of a firm clamping hold, without injury to the tool, and the securing and maintaining of alignment, even if repeated adjustments have to be made. It is usually more difficult to securely fasten the tool or cutter itself, because in a great many cases the surfaces of the cutter are not finished so accurately as the shank or stem of the holder. The unfinished surfaces of the tool often act as pivot points and give the tool a leverage action, which, under the cutting pressure, may result in chatter or even loosening of the tool. In this connection, there are two important factors to be considered. One is the use of simple bar stock in a suitable holder or clamp without any special preparation, and the other is the use of prepared pieces of steel, accurately machined or ground to the proper shape and size.

Cutters with Clamping Holes and Slots

The problem of whether or not the steel for a tool shall be left plain or shall be drilled, slotted, or grooved, to provide for special clamping means, is often encountered. Broadly speaking, it is best not to machine any holes or openings in a cutter or tool if it can be avoided, partly because of the weakening effect, the danger of cracking during hardening, and the extra expense of the machining operations. Many drilled tools have a short working life, as compared with solid tools, on account of the interference of the apertures after a period of repeated sharpening. It is generally preferable, therefore, to employ clamps instead of studs for holding the tool in place. There are occasions, however, when a tool cannot be conveniently gripped by any type of clamp, because of various reasons, such as the interference of the clamp with visibility or with the escape of chips.

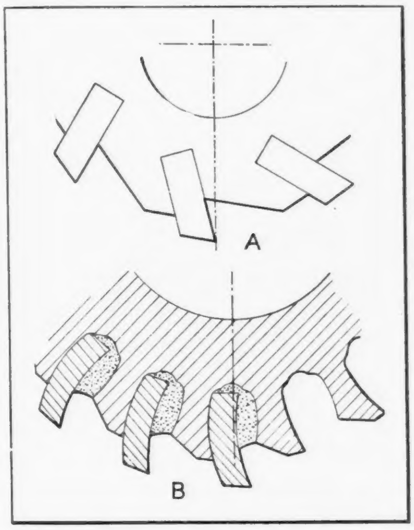


Fig. 1. (A) Sweated-in Helical Blade Type of Milling Cutter; (B) Helical Blades secured by Fusible Metal

Using Special Cross-section Steel

No troubles result from using steels of special cross-section, which are suitable for wedging or clamping in a manner that gives greater rigidity than can be obtained with steel of standard rectangular section. The tools used in some holders, such as those for side cutting or parting, are practically always machined or fitted. It is, of course, a great convenience to be able to use standard bar stock for holders, but this, though practicable for many of the turning and planing holders and various rotating cutters, cannot be done when the conditions of cutting demand a specially thin, relieved, or otherwise unusual shape of cutter. Such conditions also exercise a modifying influence on the design of the holder and its clamps.

Frequently steel of a special cross-sectional shape and a compact holder must be employed in multiple tool equipment, simply because of the close grouping of the tools and other parts of the equipment, although under ordinary circumstances a special holder might not be required. Interference with the work also affects the arrangement of screws or clamps, especially in the case of tools for internal facing and grooving operations.

Adequate Chip Clearance

Free escape of the chips furnishes another reason for modifying the usual type of clamping device employed on a tool-block or holder. It is sometimes necessary to attach special deflecting devices or to design a tool-holder for operation in an inverted position, so that no screws, clamps, or webs of metal will obstruct the free flow of chips from the work.

Care must be taken to avoid placing a screw-head or clamp close to the cutting edge of many tools, even though correctly ground cutting edges prevent the chips from curling and an ample flow of coolant is provided. A few of the more elaborate tools, such as box-tools and die-heads, must be carefully designed in order to prevent them from being clogged by chips. In some designs, the vital working parts are positively sealed against the entry of any foreign matter. In other designs, gaps or escape holes are provided through which the cuttings may flow. Some tool-holders and cases have sealing rings or guards for the total exclusion of fine dirt and chips, while in others, simple dirt or burr channels at suitable points suffice. The channels receive the fine matter which might otherwise interrupt the movement of a sliding member or other element.

Adequate Strength in Tool Body

A body large enough to withstand vibration and chatter is essential for all tool-holders. In the box-tools and multiple cutting blocks and heads used for heavy work, the severe cutting pressure is likely to spread the frame or some portion of the holder, thus introducing chatter. Any undue projection of a cutter or excessive overhang of the holder tends to cause chatter and inaccuracy. A tool-holder body that is too light or is structurally weak is quite likely to become more troublesome with use, because the pressures

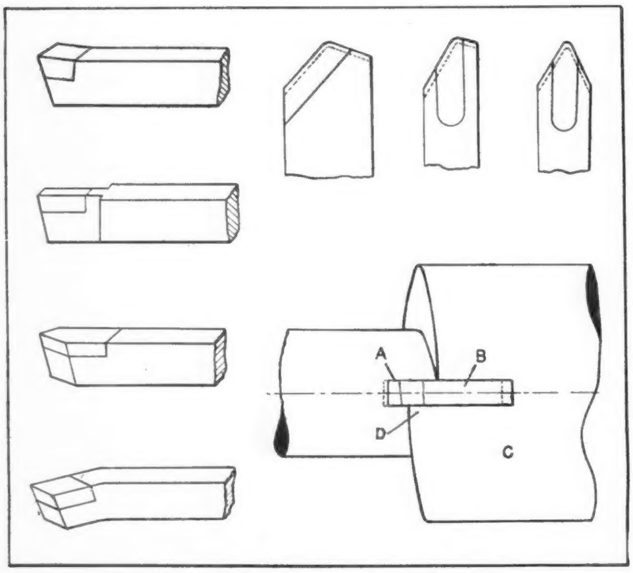


Fig. 2. Welded Tip Type of Tools

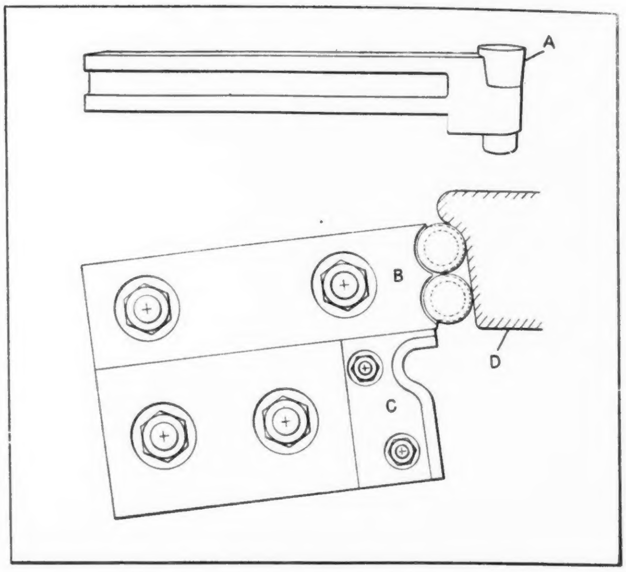


Fig. 3. Holders for Round Shank Type of Cutters

tend to force and peen the frame out of alignment. If the material of the tool-holder body is not of the best, rapid deformation of the tool-supporting surfaces will occur. Ample fillets in corners, and straightening ribs where needed, will do much to prevent failure of the holder. Sometimes two or more holders may be tied together with bolts or clamps to increase and maintain the rigidity of the equipment. Some sort of auxiliary support on which the holder can rest or slide may also be provided to give a steadying effect.

The durability of the supporting surfaces and of the screws and clamps depends partly on the stability of the holder, and ample area and good materials are necessary for long service. Hardened surfaces with serrations or separate hardened slip bearing surfaces are much used. In the higher grades of fittings, such as opening dies and collapsing taps, the question of durability depends largely on the quality and the fitting of the parts. If the various parts of the holder and blades are properly joined and fitted, there is much less chance for deformation and irregular wear to occur. Also the sliding portions will wear in a more uniform manner when the members are all carefully fitted.

The maintenance of the machine slides, spindles, etc., in proper alignment is determined partly by the condition of these elements and partly by the method of mounting and clamping the tool or holder in place. Any action that permits bruising a stem or shank soon destroys accuracy, the same as a noticeable looseness of fit in the assembled parts. In addition, faults in the indexing mechanisms must be considered; in fact, all members in which inaccuracies might exist must be carefully fitted and inspected in order to keep the accumulative error within the required limits of accuracy. Comparatively slight errors do not matter in the case of many kinds of tools, but if requirements are very exacting, as in the case of hollow mills, taps, dies, and reamers, a floating arrangement may be incorporated to set the tools in their proper positions or they may be allowed to float.

Convenience of Manipulation

In the majority of tool fastening and adjusting devices, convenience of manipulation must be studied, especially in those cases that require adjustments to be made when setting up, or where alterations must be made at various intervals while the machine is in operation. The screws, bolts, wedges, clamps, cutters, etc., must consequently be arranged in the most convenient or accessible positions. A multiplicity of adjusting tools should be avoided, and screw-heads should, as far as possible, be of the same size or limited in number so that only a few sizes of wrenches and screwdrivers will be required.

As few different lengths of screws as possible should be used, in order to facilitate making up new equipment and making replacements. Some of the more complex tool-boxes are provided with a set of uniform length screws, the varying distances from the points of the screws to the tools being made up by inserting plain pins under the ends of the screws. In some cases, where the screws must be grouped very close together, different lengths must be used, in order to bring the heads of every other screw up higher, so as to permit the wrench to be applied. A kink that can often be employed to advantage is to provide the screw-head with a knurled collar by means of which it can be rapidly twirled between the fingers.

Another point relative to convenience of manipulation is where the binding action of the screw used for fastening a tool also secures the holder or tool-block at the same time. In some cases this dual service is advantageous in that it simplifies adjustments, but in other instances, it acts detrimentally, and preference should be given to separate means of fastening the tool and the holder. In a few special instances, the tool or cutter is held in a box or case in which it is accurately adjusted. The case is, in turn, placed in the holder, so that the settings are not disturbed when changing tools. This construction permits tool settings to be accurately duplicated by taking measurements from the fixed points on the case.

There are tool fastenings and adjustments in which the movement of one screw, nut, wedge, or cam controls a set of tools or blades, so that the size is obtained at once or possibly by merely touching the tool lightly on the grinding wheel. Quick-change devices are also necessary, in some cases, in order to bring different tools into operation in rapid succession without employing the regular turret or swinging arm equipment of the machine tool. These devices include swing or leaf fittings which allow one tool to be dropped down over another. With this arrangement, a simple key or pin catch, with a handle for tightening a shank in a socket or holder, is employed so that the stems can be rapidly changed without the trouble of using a wrench. Chucks of various kinds are, of course, utilized in many cases for holding tools, but these will not be considered in this article.

A factor that has some influence on the design of tool fastenings is the conveying of coolant to the edges of the tool in some manner other than from a pipe or spray. Some types of drills and reamers have oil-holes for their entire length through which the oil is forced under pressure. Tools of this kind must, of course, have special holders designed to make proper connection between the oil-hole in the tool and the oil supply pipe. This requirement often necessitates modifying the method of fastening the tool-holder. The holder employed for a hollow drill secured to a tube and used for deep hole work is an example illustrating a condition of this kind.

Welding and Sweating Tool Bits to Holders

One of the newer developments in toolmaking practice is that of welding in bits or, in some cases, sweating or fixing them in place with fusible metal instead of employing a mechanical fastening. In the majority of cases, tool bits fastened to holders by sweating or with some fusible metal must be given the fullest possible support by the holder in order to relieve the joint from undue stress. The bit may be sunk well into the holder and so located that the thrust of the cut will not tend to tear it from its seat. In the case of stellite, it is even more important to observe these precautions, and the principle is the same as when the material is clamped in a holder equipped with any of the usual mechanical holding devices.

Probably the simplest type of tool-holder is the sweated joint type, which is used chiefly for milling cutters and various tools of like nature. The practice of casting in teeth may also be mentioned in this connection, though the sweating process is easily employed and renewals can be readily made. For slabbing cutters, the blades are bent to a helical shape, and the grooves milled to correspond with the shape of the blades. Each blade and groove is coated with flux, the blades put into place, and secured there by means of wire. The whole assembly is then immersed in a bath of molten solder, where it is left until the solder reaches a pasty consistency, at which time the surplus metal is brushed off the cutter. When cool, the cutter is ready for grinding. At *A*, Fig. 1, is shown a cutter constructed in this manner; this is a good example of the proper distribution of metal in the holder. At *B* is shown the method of mounting the blades in the helical-blade cutters made by the Tabor Mfg. Co. This holder has under-cut grooves and a considerable space at the front of each cutter into which fusible metal is poured and afterward compressed.

In Fig. 2 are shown various tools of the welded-tip type having the tips arranged in such a way that the cutting stresses are taken by the holders on which the tips are welded. Some of the examples shown are representative of the practice generally employed for stellite. Flat cutters for boring and facing, such as shown at *A*, are often made up by welding a bit of stellite to a steel plate *B* held in a bar *C*. Adequate support is thus given the stellite, and it cannot become loosened from the backing piece where the helical shoulder *D* reaches under the tool.

Plain Fitting

It is rarely possible to hold a tool or cutter securely by a plain parallel shank or stem fitting alone, without any sort of screw or binding clamp. One interesting exception, however, is found on the tool-holders made by Sir W. G. Armstrong, Whitworth & Co., Ltd., Manchester, England, for their railway wheel lathes. The tool has a head *A*, Fig. 3, about 1 1/2 inches in diameter, which is tapered slightly to provide for front clearance. The stem is cylindrical and a tight fit in the holder. The top of the head is dished slightly to give the required rake. In machining the holder the end is countersunk to fit the head, after which the front portion is cut away. This leaves a close fitting supporting wall at the back of the cutter. When the cutting edge is dulled, the tool *A* is simply loosened and turned around far enough to bring a new cutting edge into position. When the entire edge has become dull, the tool is reground.

Some of the holders for these tools are made single, as shown in the view at the top of Fig. 3, while others are of the duplex type, as shown in the lower view. The tool in the lower view is employed to rough out the tread of the wheel *D*, and finish-form the tread to the required profile with the forming cutter *C*, which is also secured to the slide-rest. In some cases, the tool *A* is threaded at the small end to receive a nut, which is tightened against the under side of the holder.

Simple Holders Employing Binding Screws

In the earliest types of boring-bars and holders for turning tools, binding screws were employed to hold the tools in place, and this method of clamping is still widely used. Perhaps the greatest disadvantage of this method is the bruising or roughing up of the tool or its shank by the end of the clamping screw. High-speed or stellite bits also require a clamping member of a more extended area than that furnished by the tip of a screw.

When clamping screws are employed, care must be taken to see that they are properly positioned or located. At *D*, Fig. 4, the screw *H* is located at the back side of the cutter, a practice that is obviously incorrect, since the cutting force would have a tendency to bend and tilt the cutter back over the tip of the screw, whereas with the screw located as shown at *E*, the cutter seats firmly against the wall of the hole in the bar.

In some cases, however, toolposts are provided with clamping screws both above and below the tool, which in this case, has no continuous metal supporting surface. The lower screws enable the tool-setter to adjust the cutting edge to the required height without the use of wedges. Adjusting screws for this purpose are often used on open-side toolposts employed on turret lathes, the clamping screws in the upper ledge being removed to permit inserting and adjusting the screws in the lower ledge. In cases where the screw-heads cannot be conveniently reached from above, the screws may be inserted from below and the ends headed over to prevent the screws from working out and dropping from the holder. The box-tool slide shown at *F* is provided with a strip *I* on which the tool rests instead of coming in direct contact with the screw tips.

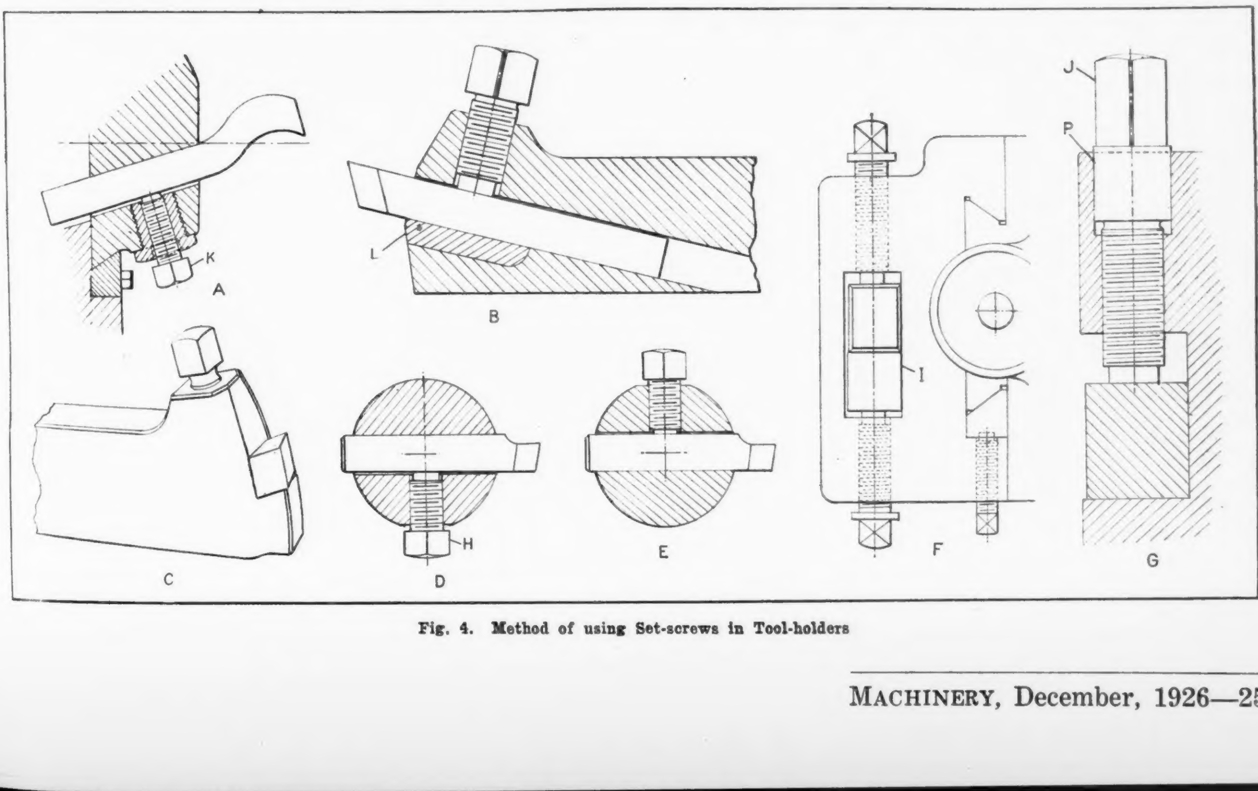


Fig. 4. Method of using Set-screws in Tool-holders

The durability of screw fastenings depends on the material, workmanship, and the extent or area of contact of the screw thread in the holder. On the Libby toolposts shown at *G*, the holding screw *J* has a plain cylindrical portion *P* which is a close fit in the reamed counterbore in the holder. This cylindrical portion of the clamping screw receives the side stress imparted by the wrench.

The holder shown at *A*, which is employed on a combination facing and boring machine made by George Richards & Co., Ltd., Manchester, England, is provided with a hardened steel bushing for the clamping screw *K*, which can be readily renewed when necessary. Durability as regards the tool-supporting surface which lies opposite the clamping screw is a subject that should receive careful consideration. The metal at this point is subjected to a severe crushing stress, and if it does not have the required hardness and strength, it may become deflected and permit the tool to get out of alignment. In some cases, it is necessary to provide justment. In some instances, the cutter itself is machined in such a manner that the end clamp in the holder will automatically locate the tool in the correct position. An example of this type of tool is the fly cutter shown at *F*. This cutter is employed to cut the teeth in a worm-wheel, and is located in the proper position in its holder by the flats ground on the end of the shank. The clamping screw, passing through the axis of the bar, automatically positions the cutter in the correct angular position when it passes by the flatted side.

At *E* is shown a turret knurling holder provided with eccentric pins by means of which the knurls can be adjusted to suit the diameter of the work. In some cases, a countersunk spot in a bar or the shank of a tool serves as a means of obtaining definite settings. This method is often employed to obtain different amounts of projection of the tool beyond the holder. A spiral arrangement of the countersunk spots provides a wide range of adjustment.

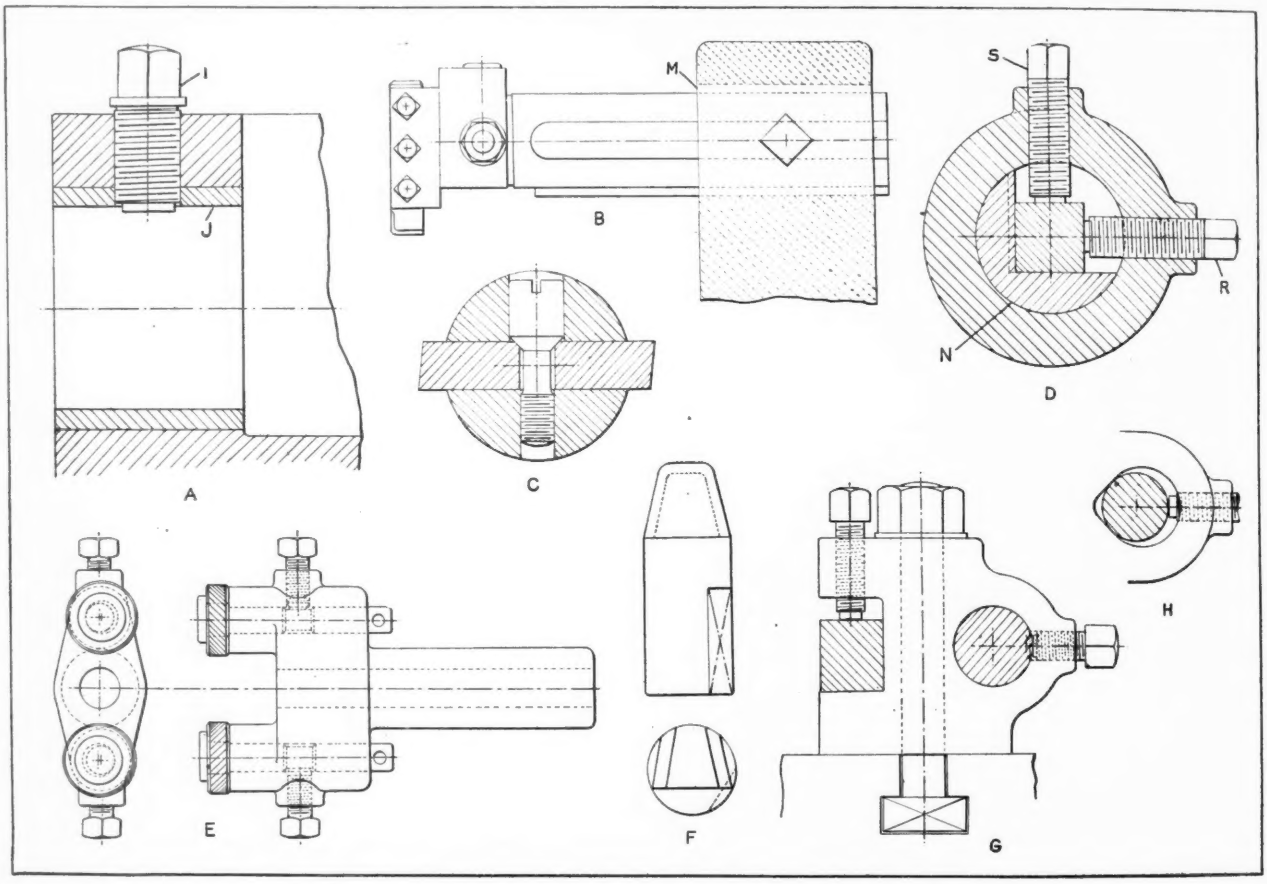


Fig. 5. Various Methods of adjusting and securing Tools in Holders

a bushing support *J*, as shown in the view at *A*, Fig. 5, which can be easily replaced and bored out while in position. In this design, the clamping screw *I* passes through a slot in bushing *J*.

At *C*, Fig. 4, is shown a holder for use on lathes and planers, which has a tool-supporting lip under the cutter. This design is employed by the Western Tool & Mfg. Co. The tool-holder shown at *B*, which is made by the Ready Tool Co., has a tool-steel insert at *L*.

Tool Locating Device

The addition of a key as a means of securing the shank of a tool clamped in the holder by a screw serves two purposes, namely, it prevents the tool shank from turning, and it allows exact settings in different position to be made when more than one keyway is cut in the holder. The tool bar gripped in a hole in the facing head of a Libby turret lathe, as shown at *B*, Fig. 5, presents an example of the "key-and-screw" method of securing a tool. A duplicate keyway *M* at the top side of the hole enables the tool to be properly positioned on the upper side of the holder. The tool in this case is held in a short slide provided with a micrometer ad-

A holder designed for tools having either square or round shanks is shown at *G*. This type of holder is used extensively on small screw-cutting lathes made in Great Britain. It is secured to the slide-rest, and is adjusted to bring either the regular square-shank tool or the boring-bar into the operating position, as required. In order to accommodate bars of different diameters, the hole is often made with a vee, as shown at *H*. At *D* is shown a holder provided with an adapter which permits either cylindrical bars or forged square-shank tools to be employed. One side of this adapter has a double slope which permits the nose of the tool to be adjusted laterally by manipulating the two screws, one of which is shown at *R*. After the tool is properly adjusted, the screws *S* are tightened. With the adapter *N* removed, the holder can be used for cylindrical-shank bars. This type of holder is employed on turret lathes made by the Foster Machine Co.

At *C* is shown a boring cutter in which a combination assembling and binding screw is employed. One of the useful features of this method of holding the cutters is the slight floating action which may be obtained by loosening the clamping screw.

The British Metal-working Industries

From MACHINERY's Special Correspondent

London, November 15

IT is impossible to review the position of the metal-working industries in this country without realizing that manufacturers are not only showing great fortitude in bearing the heavy burden that is imposed on them by the continuance of the coal stoppage, but are also showing much ingenuity in obtaining materials and fuel and in undertaking as much business as they are doing. Unemployment is still decreasing gradually, and there are now about 300,000 miners at work out of a normal total of 1,100,000. It must not be forgotten, however, that about 200,000 will probably never go back, as the industry was overcrowded before the stoppage. During October the cost of living rose from 72 per cent above the 1914 standard to 74 per cent.

At an abnormal time like the present, when all industries are convulsed, and no accurate indications can be given of the general state of any particular trade, it is well to take the opportunity of pausing and reviewing the trend of business over a longer period than usual.

Iron and Steel Industries are Suffering Financially

Financially, 1925-1926 has been the most difficult period experienced by the heavy iron and steel industries of Great Britain since the war. An idea of comparative conditions in the last six years can be obtained from a report made by eighteen of the best known concerns in the coal, iron, and steel fields, on the ratio of profits to capital. The figures give the average ratio for the years 1920 to 1926 as follows: 1920 to 1923, 5.1 per cent; 1923 to 1924, 4.8 per cent; 1924 to 1925, 2.6 per cent; and 1925 to 1926, 2.3 per cent. Thirteen of the concerns showed a net loss last year, after deducting all their expenses. The corresponding figures showing the ratio of profits to capital, supplied by fifteen firms in the engineering industries, are as follows: 1920 to 1923, 10.6 per cent; 1923 to 1924, 6.5 per cent; 1924 to 1925, 5.5 per cent; and 1925 to 1926, 6.9 per cent.

The national output in the iron and steel field, while 10 per cent less than in 1924, was twice as high as in 1921, and 25 per cent higher than in 1922, when far more creditable results were shown. The chief cause of the depression seems to have been unprofitable selling prices in consequence of fierce world competition and attenuated world demand, steel quotations being only 20 per cent above the 1913 level. High overhead costs doubtless exercised an unfavorable influence on profits, and the cumulative effects of many earlier years of depression are clearly visible in the figures for 1925-1926. Whether or not the coal industry eventually decides to enter into closer relations with the Continental Steel Cartel, the operations of the latter will, it is hoped, tend to raise European steel prices, and put the industry on a more profitable basis.

Conditions in the General Engineering Field Have Improved

Engineering industries have, on the other hand, more than recovered the ground lost in 1924-1925, although the ratio of profits remains on the low side. The textile industry found 1925-1926 a more difficult year than its predecessor, and the large shipping companies earned but moderate returns. The electrical industries showed a much larger proportion of profit to capital than in any of the last four years.

The British engineering industries' own estimates show that the exported tonnage of machinery was 74.9 per cent of the 1913 tonnage, while the corresponding figure for imports was 70.2 per cent. If the exports of the first six months of 1926 are maintained, the year's tonnage will be 70 per cent of that for 1913, or 5 per cent less than in 1925. Imports increased from 52 per cent in 1923 to 70 per cent in 1925. These figures include machinery of all kinds.

Coal Peace Prophecies Influence Metal Markets

As regards the present position, markets have been somewhat influenced by the more confident coal peace prophecies of the last few days. There is a widespread belief that maximum metal prices have been reached and that their future course will be downward. Pig iron quotations are stationary, and buyers are only taking enough to meet pressing needs. It is impossible to purchase foreign iron with any hope of early delivery.

The Shipbuilding Industry is Optimistic

The shipbuilding industry is optimistically regarding the period of recovery after the coal dispute is over. That the industry has been affected to a serious extent is shown by the statistics of tonnage launched on the Clyde this year. Only four vessels were launched in October, while the total for the first ten months of the year is only 60 per cent of that for the corresponding period last year, and only 40 per cent of the best total for the period—that of 1913. The decrease is almost wholly explained by the lack of materials and fuel, as there are large contracts on hand which would have represented a much larger output if progress could have been made with the work.

Machine Tool Industry is Receiving Inquiries

The machine tool industry is still quiet, but inquiries are good. It is hoped that negotiations pending with automobile manufacturers will mature, now that the motor show has given such a tremendous impulse to the new season's trade. Production programs are being put in hand on a considerable scale in the automobile, motorcycle, and bicycle factories, and several firms are known to be contemplating extensive increases of their plants.

As regards the machine tool exports for September, the weight of exports dropped by some 400 tons, while the value decreased by about £41,000. The total weight exported was 809 tons, valued at £93,962. The tonnage of imports rose by 240 tons, the increase in value being £9000. The imports of machine tools actually exceeded the exports in weight for the first time in September, but were of slightly lower value. The value of small tools and cutters exported during September rose by £3000—a rise of about 6 per cent over the August figures, and a figure that improves the total for the current year by 2 per cent.

Railway Engineering Plants Report Good Business from Abroad

The home railways are not placing any substantial orders at the moment, but railway engineering plants generally report good business from abroad. Considerable orders have been placed from the Argentine, India, and South Africa for locomotives, all-steel freight cars, and all-steel passenger cars, but it is, of course, impossible to make much progress while the shortage of materials and fuel is so acute.

On the whole, the position of the metal-working industries is exceedingly difficult to appreciate; some branches report a slight improvement in trade, while others are at a standstill. All branches, however, are unanimous in their outlook for the future. Once the coal dispute is settled, and it is probable that it will have been by the time this report is in print, there is no question that we shall enter on a surging wave of prosperity and, it is hoped, on a long period free from industrial upheavals and strife.

Current Editorial Comment

in the Machine-building and Kindred Industries

LUBRICATION OF MACHINE TOOLS

An equipment and maintenance engineer of long experience with a large automobile company states that the number of shutdowns of machine tools in automobile plants could be greatly reduced if all machine tools were provided with positive force-feed lubrication to all high-speed moving parts, and if a central oiling system were provided for the lubrication of all the other bearings and surfaces to be oiled.

When oil-holes are scattered all over the machine, not only is a great deal of time required to oil all the bearings, but if the operator is on piece-work, as is usual in automotive and other high-production plants, he is likely to overlook some of the oil-holes, with the result that the maintenance cost of the machine increases. The numerous oil-holes on some machines frequently become covered with chips, grease and dirt, for the operator may not even know of their existence. On one machine there are over fifty separate oil-cups and oil-holes to be attended to. This places too much responsibility upon the operator, and there is considerable risk that some of the oil-holes will be overlooked and the bearings run dry. A ruined bearing may mean a costly shut-down.

In the automobile plant first referred to, many machines had been provided with a centralized oiling system, with copper tubes leading to the various points where oil is required, after the machine had been installed in the plant. Such a centralized system of oiling could be installed better and more cheaply if it were done when the machine was built.

During recent years many machine tool builders have provided their machines with thoroughly effective means of lubrication; but the practice is not yet universal. This is an improvement that justifies an increase in the selling price of the machine, and that will save the additional cost many times over. The freedom from unexpected shut-downs, the reduced maintenance expense and the longer life of the machine are advantages embodied in well lubricated machines that are worth the small additional expense.

* * *

GRINDING WHEEL DEVELOPMENT

The remarkable progress in the design of grinding machines during the past twenty-five years is well known to all mechanics. That equally great improvements have been made in the grinding wheels may not be as thoroughly appreciated. The manufacturers of the wheels have had as many difficult problems to solve as have the makers of the machines, but both groups of manufacturers have solved their problems in a highly efficient manner that has been a wonderful help to the mechanical industries.

One of the problems that confronted the wheel manufacturers was the difficulty of producing a uniform product in quantity. In the early days, one wheel would prove to have exceptional grinding qualities; but another made as nearly as possible like its counterpart, for some unaccountable reason would fail to produce similar results. Through unceasing research work, the processes of grinding wheel manufacture now are controlled with scientific accuracy. Instead of depending, as formerly, upon the judgment and skill of individuals, the grinding wheel industry now relies upon the accuracy of scientifically developed methods and instruments. Skill and judgment, no matter how highly developed, never can produce as uniform a product as is possible when the processes are controlled by accurate instruments that measure and control each step in the manufacture.

We have referred frequently to the race between high-speed cutting tools and the machines using them. It is equally interesting to compare the successive improvements that have been made in grinding machines and grinding wheels, and to note the constant demand of machine manufacturers for better wheels and the immediate response of wheel manufacturers with wheels that required the construction of heavier machines in order to take full advantage of their cutting capacity. In only one company has the development of wheels and machines been under the same general management. In all others the wheel manufacturers have been entirely independent of the grinding machine manufacturers; yet there has been the closest cooperation with most remarkable results.

In this connection it is of interest to note the extent to which grinding wheels are now used in the industries. In the automobile plants alone, some $9,000,000 worth of grinding wheels are consumed every year. Approximately $2 worth of grinding wheels are used up in the manufacture of every car.

* * *

CLEAN SHOP WINDOWS DO PAY

The importance of good light in the shop—both natural and artificial—is thoroughly recognized, and much attention is given nowadays to providing manufacturing plants with ample light. But in many shops very little thought is given to keeping the windows clean. Dust or dirt on windowpanes of shops reduces the amount of natural light greatly and increases the electric light bill surprisingly. Poor light slows up the speed of workers, decreases production, increases mistakes, and is a frequent cause of accidents.

Definite information on the value of keeping shop windows clean was given in a paper presented before a recent meeting of the Illuminating Engineering Society. Two engineers of the Detroit Steel Products Co., W. C. Randall and A. J. Martin, in cooperation with Professor Higbie of the University of Michigan, have conducted an investigation to determine the effect of window dust and dirt on the light in shops and factories. Part of the work was done in buildings belonging to the Detroit Steel Products Co.

It was shown by repeated experiments that when the windows had not been cleaned for four months the amount of light transmitted through them was only from one-fourth to one-half the amount transmitted through clean glass. The rate of light decrease was greatest during the first weeks after the windows had been cleaned, indicating that frequent cleaning is of great value. Three-fourths of the decrease in light was due to dirt on the inside of the windows, and one-fourth to dirt on the outside. Experiments showed that the kind of glass used in the windows made comparatively little difference in the amount of dirt collected and the resulting decrease in light in the shop.

Basing their conclusions upon the results obtained from these tests, the investigators recommend that, wherever it is impracticable to clean the outside of the windows at frequent intervals, at least the inside of the glass be wiped or washed often, because dirt accumulates faster on the inside of shop windows than on the outside. Presumably, the outside of the windows is partly cleaned by heavy rains.

New factory buildings are generally provided with a large amount of window space to give ample light, but the extra window space is of little value unless the windows are kept clean. This important item in shop management should receive more attention than it usually does; a regular schedule for window cleaning should be adopted for every shop.

High-speed Chain Drives*

Effects of Sprocket Size, Chain Velocity, and Sprocket Speed

By G. M. BARTLETT, Consulting Engineer, Diamond Chain & Mfg. Co., Indianapolis, Ind.

A CURSORY inspection of the contents of mechanical journals published during the past year, and a comparison with those of a few years ago, will show a great increase in the number of articles devoted to the general subject of power transmission and power transmission machinery. A closer inspection will show that much of the attention given to that subject has to do with short-center drives from motor to lineshaft or from motor to individually driven machines. The discovery of the economies to be gained by the use of such drives has greatly increased the demand for transmission media of high efficiency that can be used with short centers and operated at high speeds, for high-speed motors are more economical both in space and in first cost.

> The important deduction to be drawn from the research work described in this article is that short-pitch chains of light weight and ample width are necessary for high-speed drives. But if short-pitch chains must be used for high speeds, the use of roller chains must be confined to light loads, whenever high speeds are desired, or a special type of roller chain must be provided, designed for light weight, short pitch, and large roller area. To do this, it is only necessary to build up standard roller chains of short pitch in double, triple, and quadruple widths. With chains of this design, it is possible to transmit two, three, and four times as much power at a given speed as is possible with single-width chains.

A "high-speed chain drive" may mean one capable of operating at high lineal velocities, measured in feet per minute, or one capable of operating with sprockets running at high rotative speeds, measured in revolutions per minute. The term "high-speed chain" may refer to either of the well-known types of transmission chains—the one known in this country as the "silent" chain and in England as the "inverted tooth" chain, and the other generally known as the roller chain. Assuming equally good design and workmanship, both types of chain are capable of operating at equally high lineal velocities, and where the same pitch and number of teeth are concerned, both are capable of equally high sprocket speeds. This article will have special reference to roller chains, since, so far as high-speed applications are concerned, this type of chain drive has undergone the greatest development in recent years; but the main principles discussed will apply in general to both types of chain. In considering this subject, four general conclusions will be presented first:

1. **The limiting conditions in a chain drive are not determined so much by high chain velocity as by high sprocket speed.**
2. **High chain velocities are possible in light weight chains of any pitch, but high sprocket speeds can only be successful with light chains of short pitch.**
3. **A single strand of roller chain can transmit only a limited amount of power at high speed, but when built in multiple widths, the amount of power that can be transmitted at a given speed can be greatly increased, and the total field of usefulness of the type of chain can be multiplied eight-fold.**
4. **Multiple strand roller chains are quiet.**

To explain how these conclusions were reached, some attention must be given to the analytical processes by means of which the working principles were brought forth. The behavior of a chain drive is affected by such primary conditions as sprocket speed, horsepower, center distance, pitch, and number of teeth; and such secondary conditions as chain velocity, chain pull, chain length, angle of bend of links, weight of links, and projected area of rollers. Other influences are centrifugal force, friction, inertia, and impact. In order to determine the exact effect of changing any particular condition, we must assume that other conditions remain unchanged.

Effect of Number of Sprocket Teeth on Chain Wear

Let us assume a very simple chain drive in which the power transmitted is 10 horsepower, the speed of each shaft is 600 revolutions per minute, the center distance between the shafts is 10 inches and the number of teeth in each sprocket is 12. The velocity ratio is then 1 to 1. What will be the effect on the wear of the chain if we double the number of teeth in the sprockets without changing any of the other given conditions? (See Fig. 1.)

For every one-twelfth revolution of a 12-tooth sprocket a chain link will turn through an angle of 30 degrees (which is one-twelfth of 360 degrees) as it wraps itself about the driving sprocket. If the number of teeth is 24 instead of 12, each link will turn through an angle only half as great. This is offset by the fact that there are twice as many bends per minute. This, in turn, is offset by the fact that the pull on the chain is only half as great, since the sprocket diameter is doubled. And again, the chain length has increased from 32 pitches to 44 pitches and the wear is thus divided among more links. Altogether, the amount of wear in each link of chain running over 24 teeth is only four-elevenths as great as when 12 teeth are used. This means that by doubling the number of teeth in this case the life of the chain is multiplied by 2 3/4. The wear of chain pins is proportional to:

$$\frac{\text{Angle of Bend} \times \text{Bends per Minute} \times \text{Chain Pull}}{\text{Number of Links in Chain}}$$

Let N = number of teeth;
S = revolutions per minute;
H = horsepower;
P = pitch;
L = chain length, in pitches; and
C = a constant.

$$\text{Since Angle of Bend} = \frac{360°}{N}$$

$$\text{Number of Bends per Minute} = N \times S$$

$$\text{Chain Pull} = \frac{396{,}000\,H}{SNP}$$

The rate of wear of chain pins is proportional to:

$$\frac{\dfrac{360}{N} \times N \times S \times \dfrac{396{,}000\,H}{SNP}}{L}$$

*Paper presented at the semi-annual convention of the American Gear Manufacturers' Association.

$$\text{or } \frac{C}{NPL} \text{ (since } H \text{ is regarded as a constant)}$$

Other things being equal, the life of a chain is proportional to $N \times P \times L$, or to the product of the number of teeth by the chain length, in inches.

Another and far more important advantage of using a reasonably large number of teeth is the greater uniformity in the chain velocity and in the angular velocity ratio between the two sprockets, due to the fact that the real pitch line of a sprocket is a polygon and not a circle, and that as the number of teeth increases, the polygon approaches more closely to a circle, and the pulsations in transmission are reduced.

Effect of Chain Velocity

The next inquiry should be as to whether the action between the chain and the sprocket teeth has been affected in any undesirable way by the increase in the number of teeth from 12 to 24 and the accompanying increase in chain velocity from 600 to 1200 feet per minute. On first thought, one might be inclined to say that since the chain velocity is doubled, the rollers must approach the sprocket teeth with twice the velocity; but this is not so, for the impact between the roller and the sprocket does not take place in a direction parallel to the chain travel, but perpendicular to it; and the velocity of impact between the roller and the bottom of the tooth space is proportional to the angular velocity of the approaching link about its pin.

The angular velocity of a chain link as it turns about its pin in the act of seating itself between the sprocket teeth is always equal to the angular velocity of the sprocket itself and is independent of the number of teeth or of the chain velocity. Hence, if the revolutions per minute remain unchanged and an increase in chain velocity does not increase the impact between the chain rollers and the sprocket teeth, we might conclude that high chain velocities are not objectionable as long as there is proper action between the chain roller and the sprocket teeth. There are three factors that may affect the correct action between chain links and sprocket teeth under high lineal velocities that would have little or no effect at low velocities. These are:

1. The inertia of the individual links as they are forced to change their direction of motion at the moment of approach to, and departure from, the sprockets.
2. The viscosity of the lubricant surrounding the pins which resists rapid flexing of the links.
3. Centrifugal force, which tends to throw the chain toward the tops of the sprocket teeth.

The effect of the first two factors—inertia and viscosity—is observable in almost any chain drive running at high speed, when there is sufficient slack in the chain. It is most noticeable at the points where the slack run of the chain is leaving the driving sprocket. At these points the chain seems to cling to the sprocket and to resist the act of unwrapping. This condition appears to have no ill effect upon the drive, and is not regarded as a deterrent to high chain velocities. The sprocket teeth have no part in this phenomenon, as was formerly supposed, and this is evident from the fact that the same thing occurs when there are no teeth and the chain is simply wrapped about a pulley. Furthermore, if an endless chain is simply hung vertically over a single driving sprocket and driven at high speed, the lower portion will behave in the same way where it is flexing on the upward run, although it is not wrapped about anything.

Centrifugal force is probably the only factor that produces a measurable effect on the action of the chain at high lineal velocities. If a chain is wrapped half way around a sprocket, the tangential force tending to break the chain would be

$$F = 0.0000043186WV^2 \text{ pounds}$$

where W is the weight per foot of the chain, and V is the chain velocity in feet per minute.

The radial force tending to throw the chain away from the sprocket is 6.2832 times as great or

$$f = 0.0000271WV^2$$

The average weight of a standard roller chain per foot is $1.63P^2$ pounds. Centrifugal force varies as the weight of the chain and as the square of its velocity. If the pitch is 1 inch and the velocity is 1000 feet per minute, the tangential stress will be 7.04 pounds, and the radial stress will be 44.17 pounds. If the velocity is increased to 2000 feet per minute, the tangential stress will be four times as great, or 28.16 pounds; and the radial stress will be 176.68 pounds.

This shows that wherever the chain is under a load greater than 28.16 pounds, at 2000 feet per minute, the tangential stress of 28.16 pounds, due to centrifugal force, will be overcome, and the chain will function properly. The normal load on such a chain will usually run from 150 to 300 pounds at that speed, and it is safe to say that velocities as high as this will not disturb the proper functioning of the chain as long as the chain tension is sufficient.

A further study of chain action reveals the fact that the chain tension decreases progressively around the sprocket from the driving strand of the chain to the non-driving

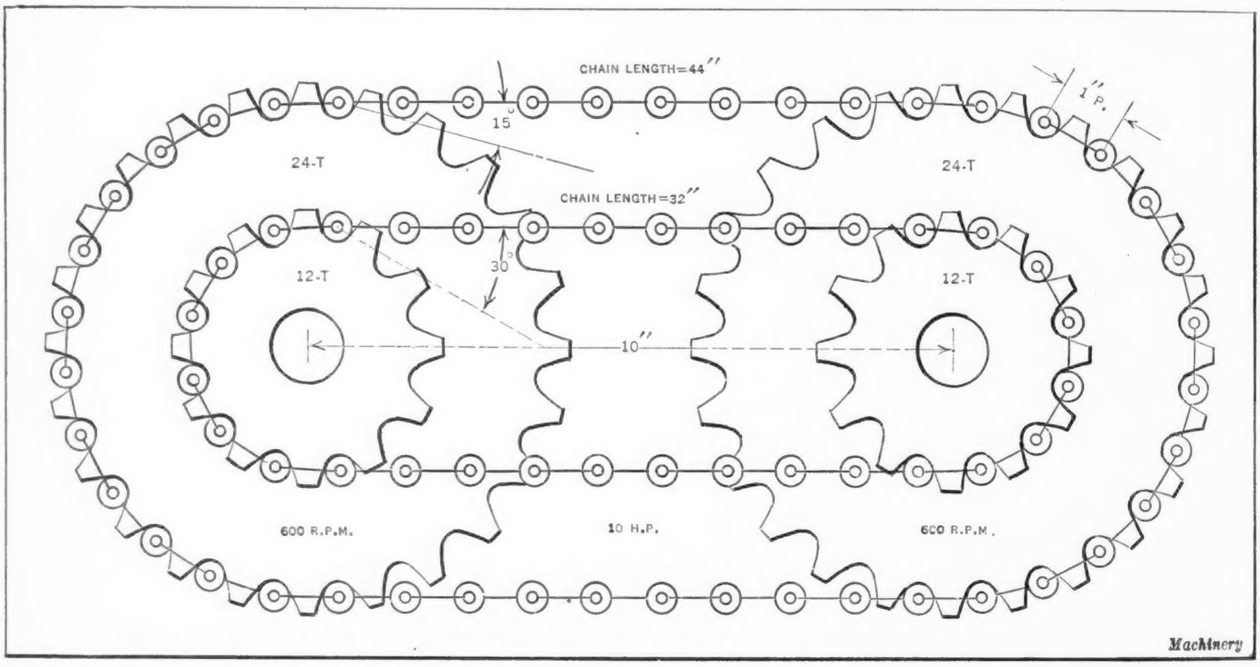


Fig. 1. Increasing Number of Sprocket Teeth increases Chain Velocity, Number of Bends per Minute, Chain Length, Smoothness of Action, and Life of Chain; and decreases Angle of Bend, Bearing Pressure, and Rapidity of Wear

strand; and there is always a particular point where the tension due to driving is zero. From that point on to the point where the chain leaves the sprocket, the tension again increases until it is equal to that produced by the weight of the slack strand of the chain.

A small amount of slack is desirable, and chain drives will usually run well when there is considerable slack in the chain. But when the velocity is so high that centrifugal force affects the correct action near points where the pull is low, it is necessary to take up most of the slack in order to avoid the tendency of the rollers to "top the teeth." If

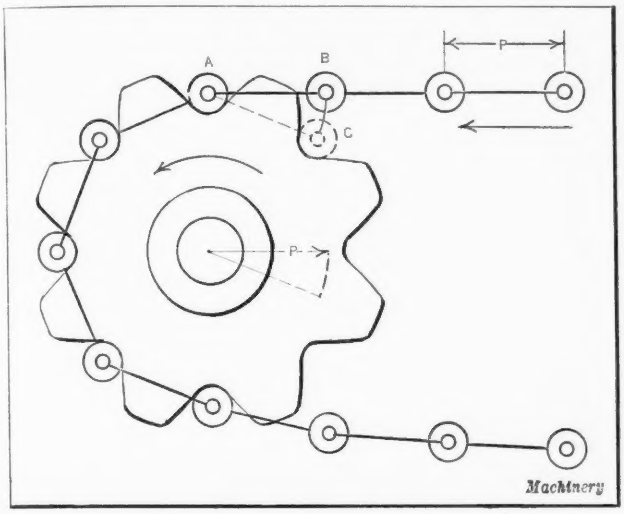


Fig. 2. Impact between Roller and Sprocket is Independent of Chain Velocity, but depends upon Revolutions per Minute of Sprockets, Pitch, and Weight of Chain

the slack is taken up, high chain velocities can be attained. It has been demonstrated, both in theory and in practice, that the ancient prejudice against high lineal velocities for roller chains was not founded upon a proper observation of the facts.

Effect of Sprocket Speeds

When there is undue wear on the sprocket teeth accompanied by high chain velocities, the trouble is usually caused by high sprocket speed (expressed in revolutions per minute), and not by high chain velocity. As engagement takes place between a chain and sprocket, each link AB (Fig. 2) turns about its pin A with an angular velocity equal to the angular velocity of the sprocket; hence, the linear velocity of the roller B along the arc BC is equal to the linear velocity of a point on the sprocket at a distance from the center equal to the pitch P. This velocity of impact is independent of the number of teeth, the angle of bend of the link, and the chain velocity. It depends only upon the R.P.M. of the sprocket and the pitch of the chain. When the force of impact becomes too great, it is destructive to both rollers and sprocket teeth; hence, it is important to investigate this subject and see whether it will throw any additional light on the design of high-speed chain drives.

The energy of one impact between a roller and a sprocket is proportional to the weight of a chain link and to the square of the velocity of impact. The destructive action between a roller and the sprocket is proportional to the energy of impact divided by the projected area of the roller (length × diameter). The velocity of impact is proportional to the R.P.M. of the sprocket and to the pitch of the chain; hence, the destructive action is proportional to

$$\frac{MV^2}{A} \text{ or } \frac{MP^2S^2}{A} \text{ or } \frac{WP^3S^2}{A}$$

where

M = weight of one link of chain, in pounds;
W = weight per foot;
V = velocity of impact, in feet per minute;
A = projected area of roller, in square inches;
P = pitch, in inches; and
S = speed of sprocket, in revolutions per minute.

Now the maximum value of this expression for destructive action, in average practice, has been found from experience to be about 4,000,000. Thus:

$$\text{Maximum value of } \frac{WP^3S^2}{A} = 4{,}000{,}000$$

$$\text{Maximum value of } S^2 = \frac{4{,}000{,}000A}{WP^3}$$

$$\text{Maximum value of } S = \frac{2000}{P}\sqrt{\frac{A}{WP}} = \text{Max. R.P.M.}$$

This formula shows that to attain high sprocket speeds we must keep the pitch short, the weight of the chain low, and the roller area high. Applying this formula to the standard series of roller chains, we obtain the maximum speeds (see accompanying table) to use as a guide in selecting the pitch of a chain before designing the drive.

The sprocket speeds shown in the third column are the highest speeds advisable for any type of chain, whether roller or tooth type; and in practice, where conditions allow it, the speeds are usually not more than 75 per cent of those given in the table.

The important deduction to be drawn from this research is that short pitch chains of light weight and ample width are necessary for high-speed drives. But if short pitch chains must be used for high speeds, then we must either confine the use of roller chains to light loads whenever high speeds are desired, or we must provide a special type of roller chain designed for light weight, short pitch, and large roller area. To do this, it is only necessary to build up standard roller chains of short pitch in double, triple, and quadruple widths, and to give proper attention to accuracy and precision of manufacture of the chain parts and also to correct and uniform heat-treatment of bearing surfaces. While precision of manufacture is important in single roller chains used for high speeds, it is of even greater importance for multiple widths. With chains of this design, it is possible to transmit two, three, and four times as much power at a given speed as was formerly the practice; and it is also possible to transmit a given amount of power at three, or four times

SPROCKET SPEEDS AND AVERAGE POWER-TRANSMITTING CAPACITIES OF HIGH-SPEED ROLLER CHAINS

Chain No.	Pitch, Inches	Max. R.P.M. of Sprocket	Average Horsepower		
			Single Chain	Double	Triple
30W	3/8	3600	1.50	3.0	4.50
40W	1/2	2600	2.25	4.5	6.75
50W	5/8	1900	3.50	7.0	10.00
60W	3/4	1500	5.00	10.0	15.00
80W	1	940	9.00	18.0	27.00
100W	1 1/4	645	13.00	26.0	39.00
120W	1 1/2	520	19.50	39.0	58.00
140W	1 3/4	370	23.25	36.5	69.50
160W	2	325	31.50	63.0	94.50

Machinery

the speed (R.P.M.) as is possible with single width standard chains. Moreover, it is a noteworthy fact that such chains are found to operate much more quietly than chains of single width.

Factors Affecting Quiet Operation

The cause of noise in a chain drive is not thoroughly understood, but the writer is fairly certain of two facts:

1. Some chain drives are noisy because of the acoustic conditions connected with the installations. The base or the casing may act as a first-class sounding board, or as a resonator. The same drives more favorably mounted may run very quietly. This phenomenon is observable with chains of both the roller and the tooth type.

2. A chain having links built up laterally of a number of similar parts will run more quietly than when each link is practically a solid mass throughout its width. The note struck by each unit in a given link will be softer; and it is possible that where the sound wave from one unit is

slightly in advance of that from another, there is a tendency to neutralization and comparative silence. This seems to be the only way to explain the fact that roller chains of double and triple width are, in general, more quiet than single width chains.

While it cannot be said that double, triple, and quadruple roller chains are new, the discovery that they are worth while seems to be part of a very recent development. As a result of this development, and recent refinements in the manufacture of chains, a given amount of power can now be transmitted by means of roller chains at much higher speeds, and much more power can be transmitted at a given speed, quietly and economically.

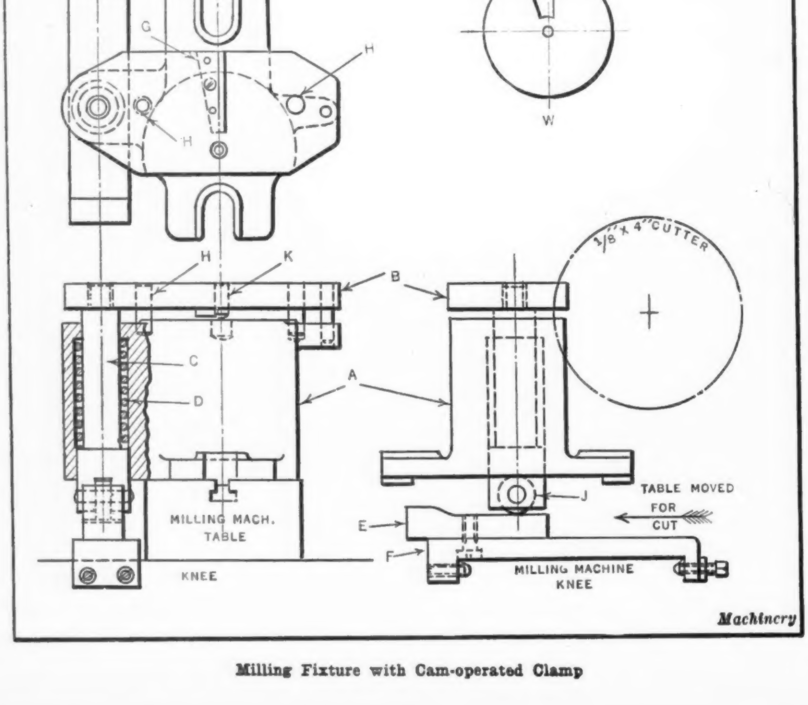
* * *

MILLING FIXTURE WITH CAM-OPERATED CLAMP

By B. J. STERN

The milling fixture shown in the accompanying illustration is employed on a hand milling machine in cutting an angular surface on the side of a slot already milled in a hard rubber disk like the one shown at *W*. The fixture consists of a base *A*, which is clamped to the table of the hand milling machine. A plate *B* is attached to the base *A* by a stud *C*, which is acted upon by a stiff spring *D*. This spring tends to bring the plate down on the base so that anything placed between the plate and the base will be securely clamped down. The cam track *E* is attached to a channel plate *F*, which, in turn, is fixed to the knee of the milling machine so that a roller *J* at the end of the stud *C* bears against the cam *E*.

In operation, the work is slipped between the base *A* and the plate *B*, where it is located by the stop-pins *H* and the angular piece *G* which bears against the straight slot already cut in the disk, thus insuring that the work is held at the correct angle for the second cut. The milling machine table is then moved toward the cutter, and the roller *J*, traveling down the face of cam *E*, releases the spring *D* which, acting against the stud *C*, binds the work between the plate and the base. As the plate comes down, the pilot pin *K* centers the disk. When the cut is finished, the table is moved back, causing roller *J* to rise on cam *E*, thus compressing the spring and raising plate *B*, so that the work can be removed and another piece slipped in place. The principles incorporated in this fixture can be readily applied in the construction of fixtures for milling operations of various kinds.

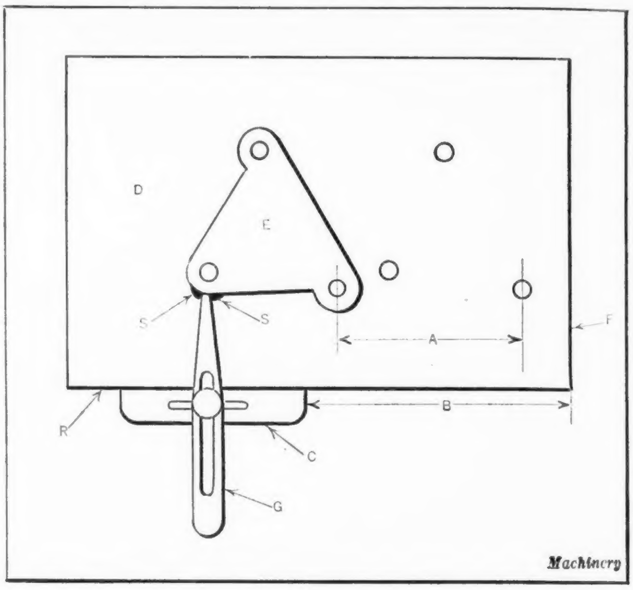


Milling Fixture with Cam-operated Clamp

TOOL FOR LAYING OUT BLANKING DIES

By CHARLES KUGLER

The tool shown in the accompanying illustration was designed to simplify the laying out of blanking dies of the progressive type when a templet is available. The device consists of two pieces of cold-rolled steel *C* and *G* having



Tool for Use in laying out Dies

slots that permit them to be clamped together with a screw and nut. The member *C* serves as a guide that can be held against the edge of the work, while the member *G* serves as a holder to which the templet *E* may be temporarily secured by a little solder at *S*. For example, the blank die *D* is to be properly laid out for blanking and piercing pieces like the one shown at *E*. In this instance, the sample piece *E* is employed as a templet in laying out the die. After the piercing holes are drilled, it is necessary to move the templet *E* along a distance *A* to the correct position for scribing the outline of the blanking opening.

This is easily accomplished by measuring from the edge *F* of the die to the end of the member *C*, as indicated by dimension *B*. The measurements can be made with a combination square or a depth gage. With the tool shown, the templet *E* can be moved along the die without changing its position relative to the edge *R*.

* * *

ALLEGED OVER-CAPACITY OF THE IRON AND STEEL INDUSTRY

It has often been stated that the iron and steel industry is over-equipped, but in view of the fact that 80 per cent or more of the theoretical capacity of this industry has been in demand continuously for two years, with the exception of only four months, it is rather difficult to maintain that there is an over-capacity. It also seems that the need for the present steel-producing capacity will continue for some time to come. August records the heaviest shipments of Lake Superior iron ore in the history of the industry. If the present rate of output continues throughout the year, the steel production will total 44,000,000 tons. In view of this enormous domestic production, the importation of 550,000 tons of iron and steel during the first six months of the year does not assume very ominous proportions. *Commerce and Finance* states the case tersely by saying, "We have never known a period of brisk business that has failed to increase imports."

A. G. M. A. Symbols for Gearing

In considering the subject of nomenclature for gearing, the American Gear Manufacturers' Association has divided the nomenclature into three distinct classifications:

A. That dealing with a description or definition of the different types of gearing, including pictorial explanation.

B. That of establishing symbols for various gear elements which have a dimensional value, and are used in formulas.

C. That relating to a description or definition of gear elements, including a plan of pictorial explanation.

Because of its importance Classification B has been taken up first, and a plan has been drawn up so that any element having a dimensional value can be symbolized, and any possible confliction avoided. This plan, which is outlined in the following, was adopted as a "suggested standard for future design" at the October meeting of the American Gear Manufacturers' Association.

The symbols have been developed in accordance with the following plan which applies (1) to single-word terms; (2) to double-word terms; (3) to angles; and (4) to special applications.

Case 1—Single-word terms, such as addendum, clearance, etc.

Rule 1—Use the first letter of the word capitalized. Example: Addendum, A; Clearance, C.

Rule 2—If there are two or more terms having the same initial letter, use the first letter in combination with the second letter in the word, the first letter to be capital and the second letter lower case. Example: Backlash, B; Backing, Ba.

Case 2—Multiple-word terms, such as circular pitch, cone distance, center distance, etc.

Rule 1—Use the first letter of each word in capitals, and in the order in which they occur. Example: Circular Pitch, CP.

Rule 2—If the combination of words results in the same combination of letters for two or more of the terms, the last word in the term should be symbolized in accordance with Rule 2 under Case 1. Example: Cone Distance, CD; Center Distance, CDi.

Case 3—Angles. (For convenience all angles have been grouped under angle, and the different angles arranged in alphabetical order.)

Rule—The first letter of the symbol is always V. The remainder of the symbol is developed in accordance with rules under Cases 1 and 2. Example: Shaft Angle, VS; Spiral Angle, VSp.

Case 4—Special Applications. (To distinguish between gear and pinion symbols.)

Rule—Use the symbol for the term followed by a lower-case sub-letter for gear and pinion, and sub-numbers for intermediates. Example: Number of teeth in gear, N_g; in pinion, N_p; in first intermediate, N_1; in second intermediate, N_2; in third intermediate, N_3; etc.

A. G. M. A. SUGGESTED STANDARD SYMBOLS FOR GEARING NOMENCLATURE

Note: Only those elements having a dimensional value are symbolized.

No.	Term	Symbol	No.	Term	Symbol
1	Active Face	AF	45	Hub Diameter	HD
2	Addendum	A	46	Hub Extension	HE
3	Angle, Addendum	VA	47	Interference	—
4	Angle, Back	VB	48	Internal Diameter	ID
5	Angle, Dedendum	VD	49	Large End Tooth	—
6	Angle, Face	VF	50	Lead	L
7	Angle, Helix	VH	51	Linear Pitch	LP
8	Angle, Lead	VL	52	Line of Action	LA
9	Angle, Normal Pressure	VNP	53	Line of Centers	—
10	Angle, Pitch	VPi	54	Normal Chordal Thickness	NCT
11	Angle, Pressure	VP	55	Normal Circular Pitch	NCP
12	Angle, Root	VR	56	Normal Involute Pitch	NIP
13	Angle, Shaft	VS	57	Normal Diametral Pitch	NDP
14	Angle, Spiral	VSp	58	Normal Tooth Profile	—
15	Arc of Action	AA	59	Number of Teeth or Threads	N
16	Arc of Approach	AAp	60	Outside Diameter	OD
17	Arc of Recession	AR	61	Pitch Circle	—
18	Back Cone	—	62	Pitch Circle Circumference	PCC
19	Back Cone Distance	BCD	63	Pitch Cone	—
20	Backing	Ba	64	Pitch Diameter	PD
21	Backlash	B	65	Pitch Line Element	—
22	Base Circle Diameter	BCDi	66	Pitch Point	—
23	Bottom Land	—	67	Pitch Surface	—
24	Bore Diameter	BD	68	Root Circle	—
25	Center Distance	CDi	69	Root Diameter	RD
26	Cone Element	—	70	Root Cone	—
27	Chordal Addendum	CA	71	Small End of Tooth	—
28	Chordal Thickness	CT	72	Space Bottom	—
29	Circular Pitch	CP	73	Throat Diameter	TD
30	Circular Thickness	CTh	74	Throat Increment	TI
31	Clearance	C	75	Throat Radius	TR
32	Cone Center	—	76	Toe	—
33	Cone Distance	CD	77	Tooth Bearing	TB
34	Crown Circle Diameter	CCD	78	Tooth Face	TF
35	Dedendum	D	79	Tooth Fillet	TFi
36	Diameter Increment	DI	80	Tooth Flank	TFl
37	Diametral Pitch	DP	81	Tooth Surface	—
38	Edge Round	ER	82	Tooth Top	—
39	Face Advance	FA	83	Top Land	—
40	Face Cone	—	84	Top Round	TRo
41	Face Cone Height	FCH	85	Under-cut	—
42	Face Width	FW	86	Whole Depth	WD
43	Gear Ratio	GR	87	Working Depth	WDe
44	Heel	—			

Machinery

WORK-HARDENING PROPERTIES OF METALS

The work-hardening properties of metals as related to metal-cutting operations and cutting temperatures are dealt with in an unusually comprehensive paper to be presented at the annual meeting of the American Society of Mechanical Engineers by Edward G. Herbert of the firm of Edward G. Herbert, Ltd., Manchester, England. The principal object of the extensive investigations that have been made by Mr. Herbert has been to bring into correlation with the operation of cutting tools, certain groups of well established and generally recognized facts, chief among which are: (1) The fact that metals are hardened by any process that deforms them so as to cause a permanent change of shape while they are at low or moderate temperatures (a process that is generally referred to as "cold work"); (2) the fact that metals are deformed and are therefore hardened by cutting tools; (3) the fact that heat is generated by the deformation of metals and in a preeminent degree by metal-cutting operations; and (4) the fact, now known for some time, that the degree of hardness induced by working metals, with cutting tools or otherwise, is greatly influenced by the temperature at which the deformation takes place.

The limiting factor in the rapid removal of metal, and therefore in the productivity of the metal-working industries, is, ultimately, the temperature generated in cutting in relation to the capacity of the cutting tool to withstand high temperatures. Mr. Herbert's paper deals with the heat-producing properties of the work rather than with the heat-resisting properties of the tool, and his general conclusions are as follows:

1. A tool cutting a ductile metal work-hardens the metal before cutting it. In so far as the machineability of a metal depends on hardness, it must depend on the hardness induced by the tool and not on the original hardness.

2. Metals differ greatly in their capacity to work-harden. This capacity is capable of measurement by a test comprising a succession of alternate rolling operations and hardness measurements on the same spot. The hardness so induced and measured increases to a maximum, and declines with further rolling. The "maximum induced hardness" is a measure of the principal factor in the machineability of ductile metal.

3. Cast iron, though capable of being hardened by cold work, is not appreciably hardened by a sharp cutting tool. Its work-hardening capacity is not generally a factor in its machineability, though it may be under special conditions. Other metals, such as brass, are intermediate between cast iron and steel in respect to the degree of plastic deformation and of work-hardening caused by the tool, and in respect to the influence of their work-hardening capacity on their machineability.

4. The built-up edge is the actual cutting implement when obtuse-angled tools are used on ductile metal, and is formed by the welding together of successive layers of metal derived from the zone of separation. It is much harder than the metal from which it is built up, and assumes a cutting angle appropriate to the cutting conditions under which it is formed.

5. Tools of high-speed steel when cutting at maximum output generate temperatures approximating 500 degrees C. (932 degrees F.) even when artificially cooled. This temperature occurs where the chip impinges on the tool. It is the maximum cutting temperature and the temperature that the tool must be capable of withstanding without softening. A temperature gradient exists in the metal ahead of the tool, and the separation of the chip takes place at a point on this gradient that is not exactly determined, but is much below the maximum cutting temperature.

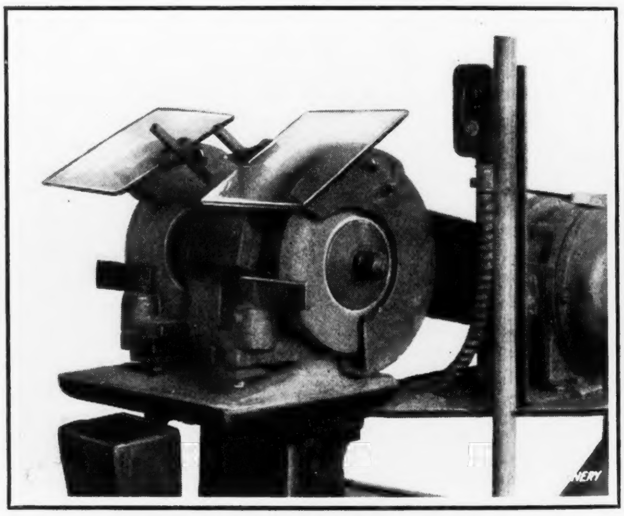
6. Steels, non-ferrous alloys, and pure metals undergo a series of remarkable changes at temperatures generally below 300 degrees C. (572 degrees F.). These changes are manifested by fluctuations in their capacity for work-hardening. Six definite change points, three maximum and three minimum, generally occur in steels, and of these at least five are usually capable of identification in non-ferrous metals and alloys. The principal change is a low work-hardening capacity occurring in steels at 120 to 140 degrees C. (248 to 284 degrees F.), and in brasses and bronzes and some pure metals at 40 to 70 degrees C. (104 to 158 degrees F.). From the fact that analogous changes occur in metals dissimilar in physical characteristics, it is to be inferred that the changes are connected with that which is common to all of them, namely their crystalline structure. Changes analogous in character, in sequence, and in the temperatures at which they occur have been found in the limit of proportionality in torsion in the case of steel.

7. The changes in work-hardening capacity are not known to affect the structural uses of metals, but have a marked effect on their resistance to severe deformation such as occurs under the action of cutting tools. In particular, the decline in work-hardening capacity of steel at the D2 or "free cutting range" of temperatures, about 130 degrees C. (266 degrees F.), is accompanied by a lessened vertical force on the tool, a lessened generation of heat, a different character of chip, a smoother finish on the cut surface, and a great increase in the durability of the tool when cutting within that range of temperatures.

* * *

GLASS GUARDS FOR TOOL-GRINDERS

Guards made of heavy plate glass are applied, as illustrated, to small tool-grinders in the shops of the General Electric Co., Schenectady, N. Y. It has been the experience of this company that greater definition of work being ground is obtained when a plain glass guard of this type is used than when a metal frame covers the edges of the glass. Cleaning of the glass is also more easily accomplished than when a frame is provided. Both guards are adjustable up and down.



Small Tool Grinder equipped with Frameless Glass Guards

* * *

The exports of industrial machinery from the United States during the month of September—the last month for which complete statistics are available—reached a total of $14,391,000, representing the largest volume for any month in 1926, with the exception of April, which is the record month since 1921. The volume of American industrial machinery exports has been steadily rising since 1921, and this progress has been maintained during the present year. The average of the monthly shipments for the first nine months of 1926 amounts to $12,988,000, as compared with slightly less than $12,500,000 for each month in 1925. The greatest growth in exports is shown in mining, oil-well, and pumping machinery. The exports of metal-working machinery in September, 1926, were valued at $1,585,000, as compared with $1,625,000 for the corresponding month last year.

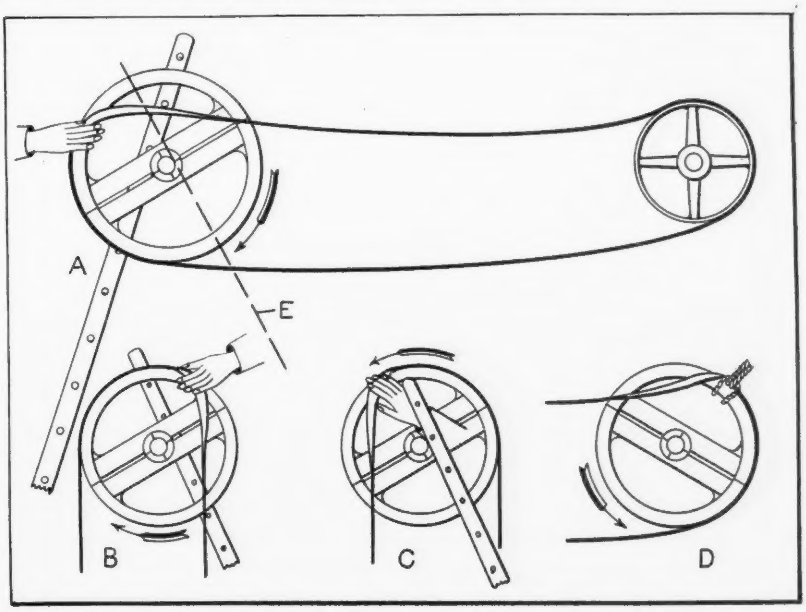
PRECAUTIONS IN PLACING BELT ON REVOLVING PULLEY

By JAMES H. RODGERS

A feature of factory operation that involves considerable risk for the workmen is that of throwing belts off and on pulleys while they are in motion. If it were necessary to stop the shafting or even slow it down every time a belt was required to be placed on or removed from a pulley, production would be greatly reduced. For this reason, the practice of throwing belts on and off moving pulleys will probably never be discontinued. We should, however, practice the safest means of performing this work.

There is less risk in throwing a belt off than in throwing it on a pulley. Often a belt comes off of its own accord, owing to slackness, poor alignment, broken lace, or one of many similar causes. When a belt must be thrown off, a suitable stick is generally used, but care must be exercised in its manipulation. Pressure should be applied on the leading side of the belt, that is, the side that is passing "on" to the pulley, and it should be seen that sufficient space is available at the side of the pulley to take the belt without interfering with adjoining pulleys, hangers, or couplings. If belts are thrown off regularly for purposes other than making repairs, means should be provided to support the belt so that it will not rest on the revolving shaft.

When a belt is being placed on a pulley, it should first be located on the "dead" or driven pulley, as shown in the upper view of the accompanying illustration, the actual "running on" of the belt being done on the driving pulley. As the latter is usually mounted on the main shaft, a ladder is necessary. In placing the ladder, care should be taken to locate it on the outside of the drive shaft, as shown at *A* in the illustration. Except in special cases, when the drive shaft is located along the wall, it is not advisable, and is often dangerous, to place the ladder in the position indicated by the dotted line *E*. When it is absolutely necessary to locate the ladder in this position, the shaft should be stopped and the belt run on at a slow speed.



Diagrams illustrating Correct and Incorrect Methods of throwing on Belts

When standing on a ladder for work of this kind, avoid placing the body in a strained position, and keep one hand on a fixed object for support. For the lighter sizes of belts, it is seldom that the speed of the driving shaft is reduced, as a workman soon acquires the knack of running the belt on the pulley. In the case of heavier belts, the work is more difficult, and skill is acquired only after considerable practice. When the belts are very heavy or unusually tight, or when there is a load on the belt, it is not such an easy matter to "snap on" the belt, and it will slip while the speed is being accelerated. Under these conditions, however, care must be taken to see that the belt does not run off the driven pulley. On narrow pulleys, there is always the possibility of the belt jumping off on the opposite side, and to prevent this, it is not unusual to place the ladder close to and on the opposite side of the pulley from that on which the belt is run, as indicated at *A*, with the lower edge bearing against the pulley, so that it serves as a guide for the belt.

On vertical drives the same precautions are necessary as on the usual types. The correct method of throwing on the belt is illustrated at *B*. The belt is gathered and placed at the far side of the pulley and drawn around to the near side, the ladder being placed as shown. A dangerous practice is shown at *C*, where the belt is placed at the near side and followed on by the hand to the far side of the pulley. This brings the arm in close proximity to the shaft at the final jump of the belt as it runs on the pulley. Under these conditions, the workman, or part of his clothing, may become caught by the shaft or between the belt and the pulley. When it is necessary to place the ladder in the position shown in this view, the workman should stand well up on the ladder and it is also advisable that the speed of the shaft be slowed down.

If the belt is too tight or too heavy for the hand method, the method shown at *D* may be employed. By means of a light rope, the belt is locked to the pulley and drawn on slowly by revolving the shaft. In handling belts, every possible chance for accidents should be considered, and a "safety first" course pursued at all times.

* * *

The Fourth General Congress of the International Chamber of Commerce, in which the Chamber of Commerce of the United States participates with a large number of delegates, will be held in Stockholm, Sweden, next year, the Congress opening on June 27. An American subcommittee, headed by Julius H. Barnes, of the International Chamber's Committee on Trade Barriers, has just submitted a report on the difficulties encountered by American business in the promotion of foreign trade. The Trade Barriers Committee, representative of the leading commercial countries, has been set up to study artificial restrictions and impediments to international trade, such as unreasonable customs regulations, arbitrary export and import prohibitions, excessive consular fees, and similar subjects.

* * *

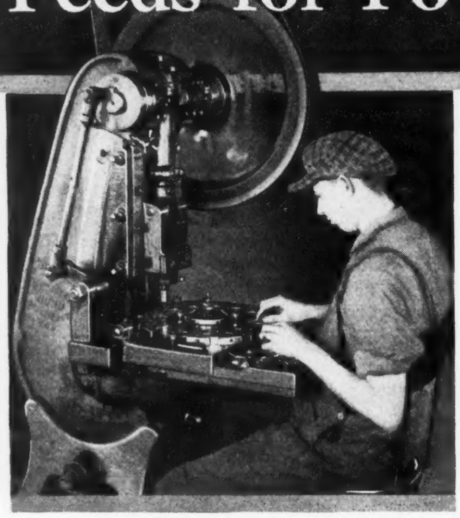
WASTE OF LABOR

I read with great deal of interest Mr. Gray's article in November MACHINERY on preventing waste in the shop. This is all very well as far as the individual shop is concerned, but as far as our national prosperity is concerned, the real waste is the waste of labor—the waste through unemployment. Whether this unemployment is due to lack of willingness to work or inability to find employment, the waste is just as great. Whatever can be done to keep every able-bodied man regularly employed at some occupation will contribute to our national prosperity. The loss due to the waste of unemployment during a serious industrial depression, in a single year, if measured in dollars and cents, would mount up to a sum greater than our total expenditures during the World War. This is not a mere guess, but can easily be calculated from existing statistics. E. R.

* * *

The New York Edison Co. has recently placed an order for a 250,000-cross-compound turbine which will be 1700 times as powerful as the first generating units employed in the New York electric service by Thomas Alva Edison forty-four years ago.

Mechanical Feeds for Power Presses



Various Classes of Feeding Mechanisms and Conditions Governing their Application—Concluding Article

By E. V. CRANE, Mechanical Engineer
E. W. Bliss Co., Brooklyn, N. Y.

THE first installment of this article (see November MACHINERY, page 161) dealt with the advantages of mechanical feeds, their relation to the design of the press, and the methods of driving them. In this, the concluding article, various important types of feed mechanisms will be described, including roll feeds, station dial feeds, friction dial feeds, drum feeds, indexing feeds, magazine feeds, pneumatic suction feeds, gravity chute feeds, the conveyor type, and hopper feeds.

Roll Feeds

Roll feeds, suited to feeding strip or ribbon stock by means of intermittently driven rolls, are quite universal in their range of work, when properly designed, and are readily adaptable to standardization, when they are built in sufficient quantity. The whole feed can be built as a self-contained unit on a bolster plate, with merely a driving collar or arm for the end of the shaft. Fig. 13 shows such a feed; it also shows a method of attaching a scrap roll as part of the feed. Roll feeds may be arranged to operate either front and back or right and left (the most common method) on gap frame presses, and front and back on straight-sided presses or right and left on such presses when arrangement can be made to feed through an opening in the housing.

Single roll feeds are those having only one pair of rolls at one end of the bolster, adapted either to pushing across the die, stock that is sufficiently stiff to preclude the chance of buckling, or to pulling the strip across by the scrap, where the scrap is strong enough not to break and is not too deformed. Double-roll feeds are built with a pair of rolls at each end of the bolster, so that the pulling stress on the stock is somewhat distributed and the material between the rolls is kept taut, preventing wrinkling or buckling; they are therefore suited especially to very thin or narrow material or to material lacking stiffness and body, though they are often used with heavier materials for control at start and end.

Fig. 11 represents a single-roll feed properly constructed according to prevailing ideas. The driving block *A*, which fits the protruding end of the shaft, is slotted and arranged with a screw *B* by which the crankpin can be moved to change the stroke of the feed. Other drives previously described can be used for quick-action work, i.e., a feeding stroke of less than 180 degrees. The connecting-rod *C* is arranged to be in tension while feeding. The friction device *D* on the lower roll shaft, drives through a set of hardened steel rolls carried in wedge-shaped spaces and arranged to engage instantly at the beginning of the forward stroke and release instantly on the return. The plain pawl and ratchet wheel (such as is illustrated in Fig. 4 of the first installment) is sometimes used in place of this device, but is noisier and cannot be set as closely, since the least adjustment possible is one full tooth on the ratchet wheel.

The rolls are geared together and are provided with a friction brake to take up any backlash and prevent lost motion from affecting the feed stroke. Bronze bearing blocks *E*, fitted in the frame, carry the rolls in true and ac-

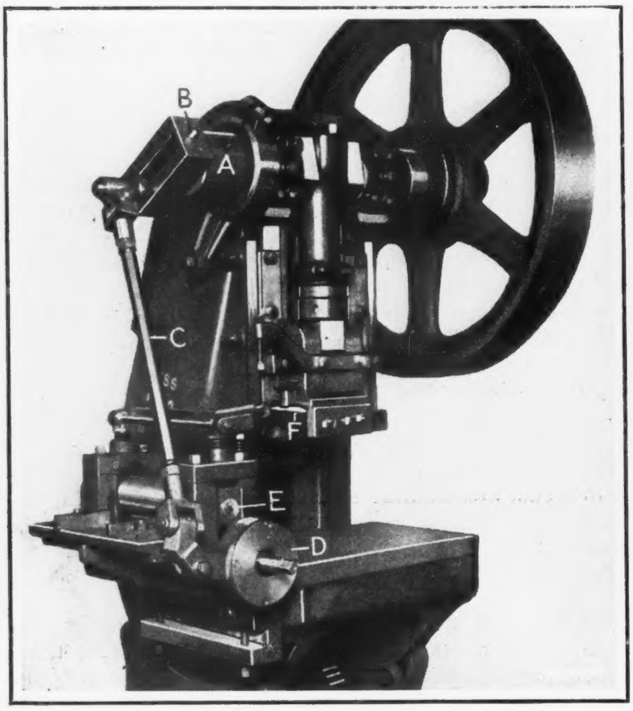


Fig. 11. Single-roll Direct-connected Feed of Approved Design

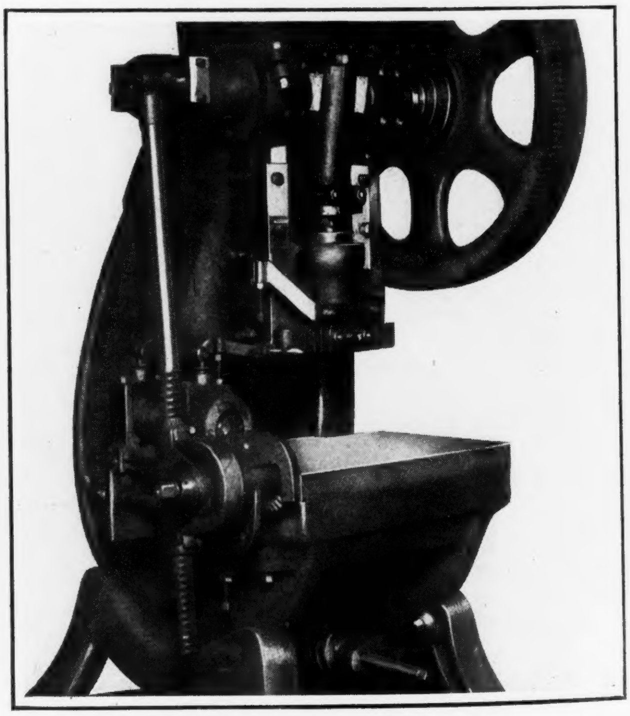


Fig. 12. Rack-driven Single-roll Feed for Longer Feeding Strokes

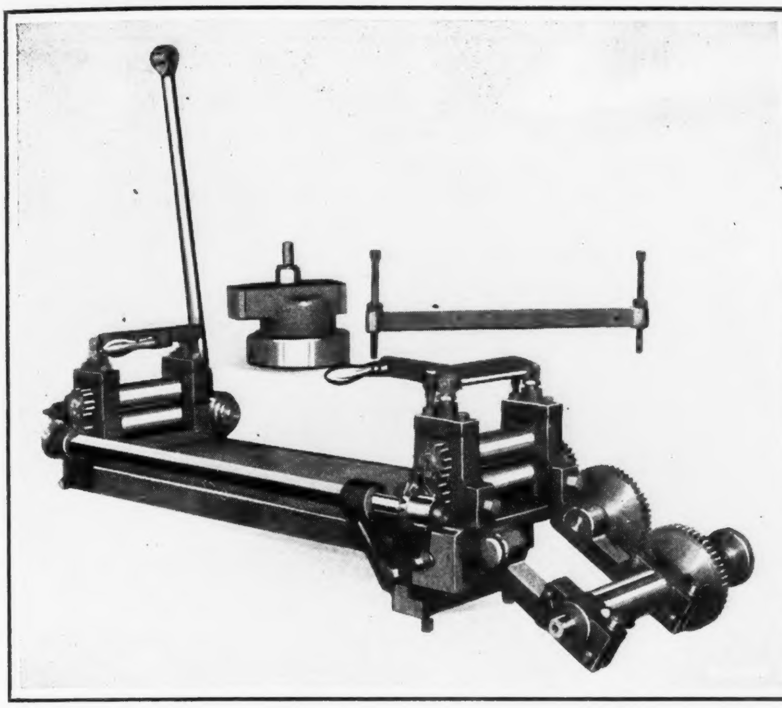


Fig. 13. Double-roll Feed built as a Self-contained Unit on a Bolster Plate

curate alignment. The whole frame is adjustable vertically to suit the die height, and guides provided in front of the rolls are adjustable to suit the width of the stock. Adjusting bushings on top of the roll housings regulate the springs which exert the gripping pressure. To relieve this pressure on the stock, the handle *F* works through these bushings and may be operated by hand when starting a new strip, or by the adjustable set-screw on the slide bracket when using punches with locating pilots or whenever it is advisable to relieve all tension on the stock just before the punch strikes it. Note that provision has been made for adjusting this feed in practically every detail, making it universal within its range. The design is such that the opportunity for wear to affect the accuracy of the feeding is very limited.

Roll feeds may be standardized for two or three maximum widths of strip and lengths of feed, covering the requirements for small inclinable and straight-sided gap presses. In special cases, of course, the same principles can be applied to extra long strokes and to special widths, as, for instance, for double-crank presses, one of which is illustrated in Fig. 15. The length of the feed is governed by the diameter of the rolls and by the arrangement. The direct-connected feed shown in Fig. 11 is limited to a maximum feeding arc of about 100 degrees. Longer feed strokes are obtained by the use of a rack connected with the crank block and driving a gear having the friction grip device built into it; such a feed is shown in Fig. 12. For an accurate feed, especially of the friction type, there should be the least possible opportunity for backlash between the friction device or ratchet and the rolls.

Double-roll feeds are very similar to the single-roll type, requiring merely the addition of a practically identical housing and pair of rolls. For short feeds, the second pair of rolls is provided with another friction device, which is driven from the first pair by the reciprocating motion of a connecting cross-bar. When the feed exceeds 90 or 100 degrees on the rolls, bevel gears and a connecting-shaft are used.

There are various accessory attachments used occasionally with roll feeds to suit special conditions. These include strip oiling and straightening devices and scrap-cutting shears or scrap-winding reels. Scrap-winding devices (one of which is shown at *D* with a double-roll feed on the press illustrated in Fig. 8, of the first installment, and another at the right in Fig. 13) coil up the scrap material so as to make subsequent handling easy. Another method with a similar object is to provide a small gate shear driven from the slide or shaft of the press to cut off a portion of the scrap at each stroke, so that it falls into a barrel or tote box and no rehandling is necessary.

Station Dial Feeds

Station or ratchet dial feeds consist essentially of a dial having stations to hold the work being operated on, and driven from the press shaft by a suitable ratchet mechanism, so that the stations are brought successively, accurately and positively under the punch. Fig. 16 shows one of these feeds very well. The drive is from the simple crank disk *A* on the end of the shaft, although in some cases, it is necessary to use a cam drive or scotch-yoke drive where less than 180 degrees is available for feeding. The driving action reciprocates a slide *B* carrying the feeding pawl *C*, which advances the dial *D* by one station each revolution. Two other pawls at *E* and *F* are arranged to lock the dial against shifting or accidental rotation in either direction. The one that locks against forward motion is relieved each time just before the feeding stroke starts by contact with the lug on the feed slide.

As a safety device, an attachment is sometimes added having a gage finger arranged to enter one of the notches in the side of the dial, if the alignment is correct; but if the dial has failed to index properly for any reason, the finger cannot enter the notch and will then trip the clutch preventing completion of the stroke. Pick-off and knock-out devices are also used as required with this style of feed.

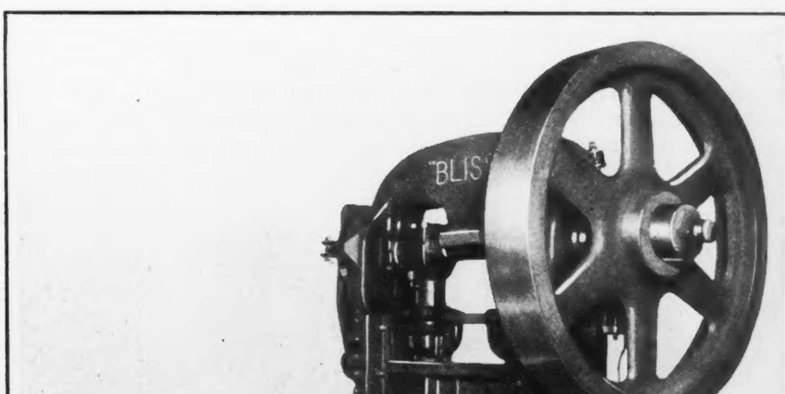


Fig. 14. Press for punching Large Sheets, having a Continuous Conveyor Feed of the Band Type

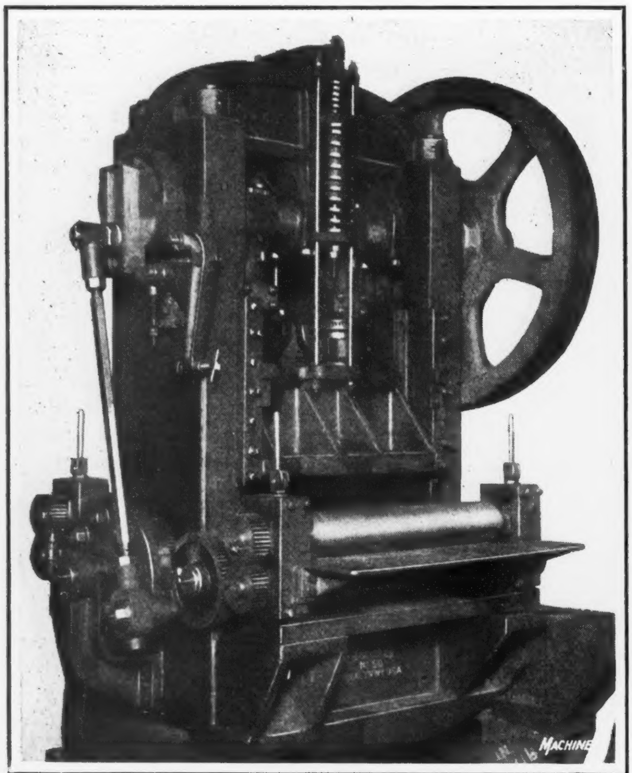


Fig. 15. Double Crank Press equipped with Roll Feed

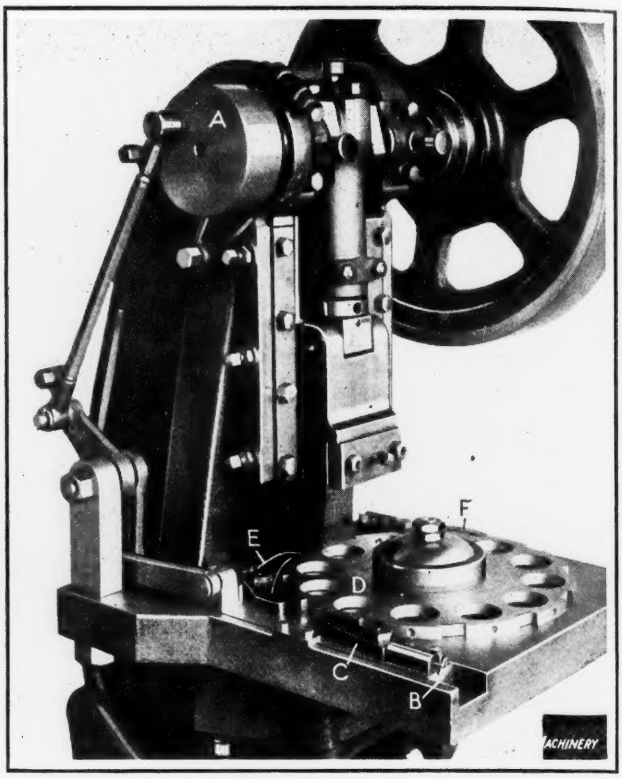


Fig. 16. Mechanism of a Station Dial Feed

The dials are of two general classes—those having a locating bushing in each station on the dial to carry the work into alignment over a die in the bolster below the dial; and those having a complete die at each station on the dial. Fig. 23 shows examples illustrating these two classes in a general way. The dial shown in the heading illustration has separate dies at each station, although they are simple ones, as the operation is only push-through forming.

Obviously, the structural requirements of this type of feed are that the dial shall move smoothly and accurately, that the notches and stations shall all be very accurately located and machined so that the work will be properly aligned with the punch every time, that the feed motion shall function accurately and reliably, and that lost motion and the opportunity for wear shall be reduced to a minimum. Dial bushings or dies must be interchangeable. The class of machine work required on a dial feed is very high.

These station dial feeds are adapted especially to handling work for secondary operations, such as redrawing, piercing, stamping, broaching, wiring, punching, and burring. Sometimes it is possible to perform two or three operations in sequence at successive stations. In such cases, it is advisable to balance the operation so that the strain on the slide will not be much off center, and to provide separate adjustments for height on the punches. Feeds of this type are also used for assembling, riveting, and closing operations on finished parts and on material other than metal.

As these feeds are ordinarily arranged, the operator places the work in the bushings or on the posts at the front of the dial, from which point they are carried around into the working position and then ejected. An unskilled operator can catch every stroke of a press that is operating at full speed, and can accomplish this without any danger of losing a hand.

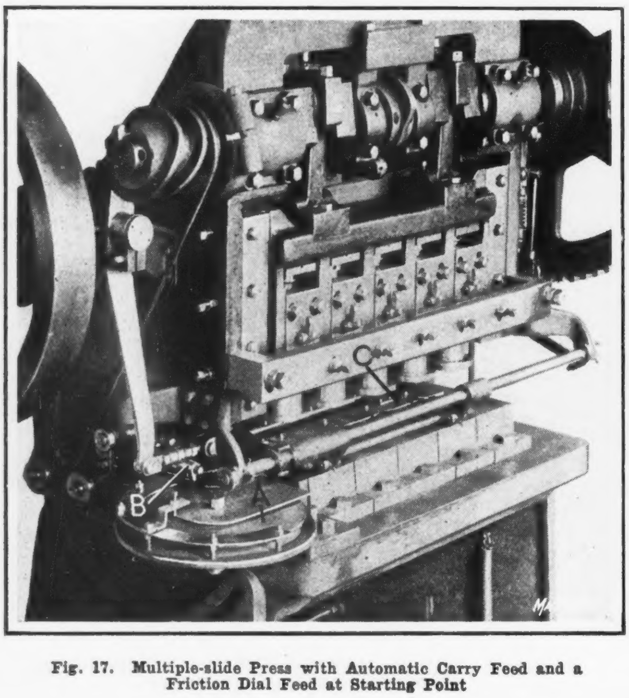


Fig. 17. Multiple-slide Press with Automatic Carry Feed and a Friction Dial Feed at Starting Point

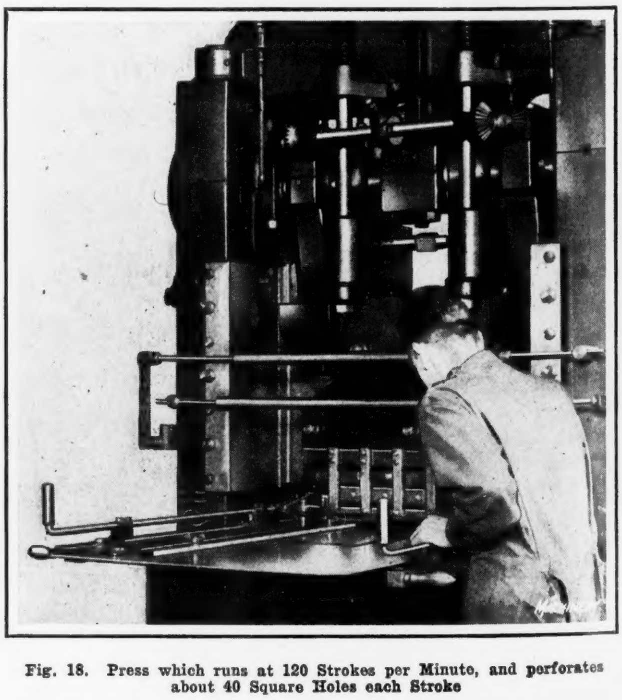


Fig. 18. Press which runs at 120 Strokes per Minute, and perforates about 40 Square Holes each Stroke

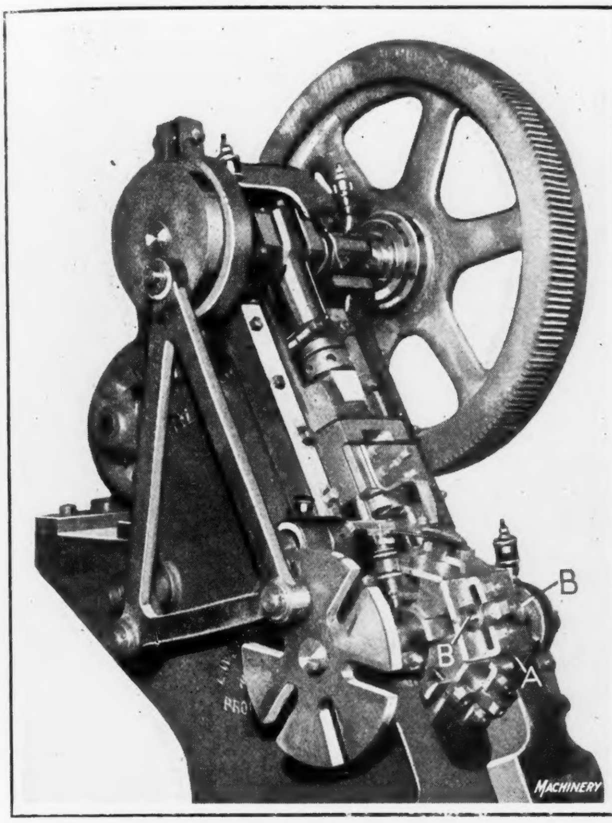


Fig. 19. Drum Type of Feed with Modified Geneva Motion

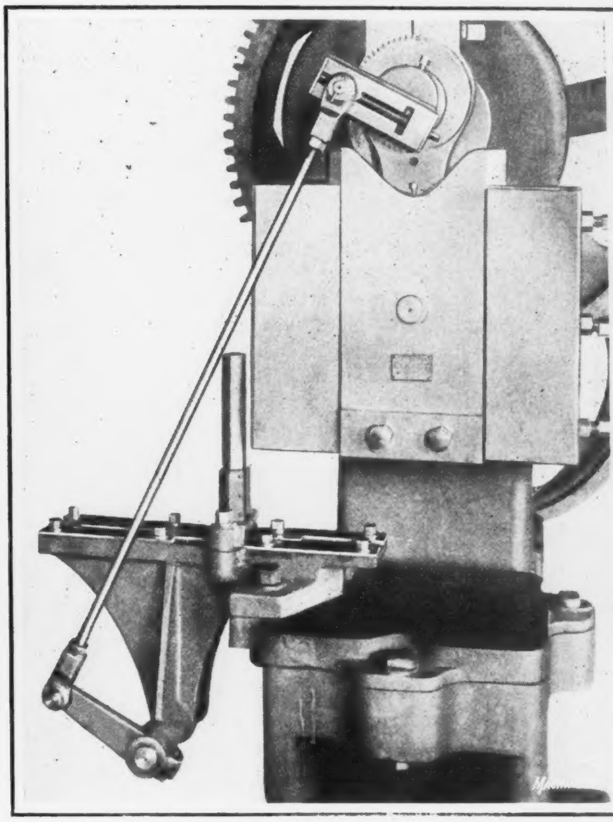


Fig. 20. Simple Design of Magazine Feed

Friction Dial Feeds

Fig. 24 represents diagrammatically a plan of a typical friction dial feed. This is a comparatively simple type of feed consisting, as a rule, of a table, a revolving friction disk on which are suitable guides, and a lateral feed or escapement. The operator has only to push the shells from the table to the disk, right side up. The combination of the friction drive and the guides lines them up and the escapement feeds the pieces one at a time into the die or series of dies. This type of feeding mechanism is suited especially to handling parts (usually drawn shells) that have their center of gravity low enough so that they are not likely to tip over.

The example shown in Fig. 24 is arranged for a simple redrawing operation. The escapement lever releases one shell, pushes it on the die, and holds it until the slide descends. In this case, the work is pushed through the die, but ejectors or conveyors can be supplied if necessary. The action is very simple and fast, and an unskilled operator can keep up with quite a high press speed without danger or nervous strain.

In the case shown, both the friction disk and the arm are driven from a single vertical shaft geared to the press shaft. In some instances, special lateral transfer feeds are required, especially where more than one operation is to be done in one press. An example of this is the case of the multiple-slide presses which are fitted with automatic carry feeds, but which usually have friction dial feeds to start the shells. Fig. 17 shows a machine of this type equipped for performing five successive operations. The friction disk is indicated at *A*, the escapement at *B*, and the transfer feed grippers at *C*.

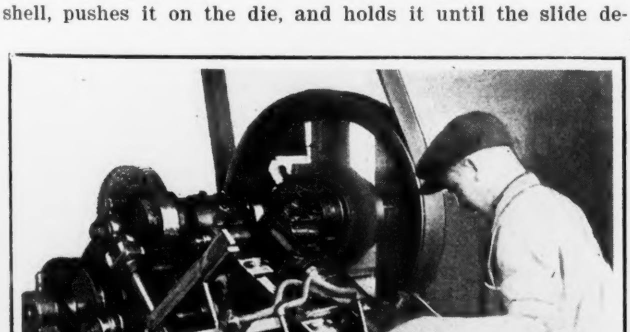


Fig. 21. Press equipped with Pneumatic Suction Feed

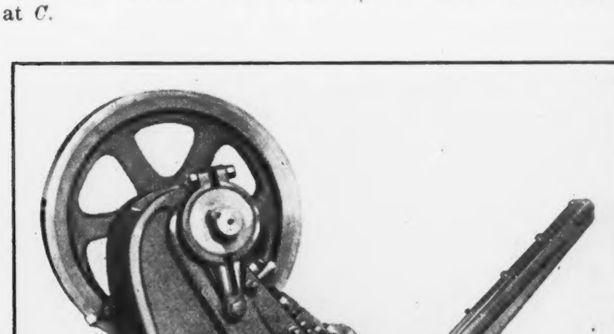


Fig. 22. Chute Feed applied to an Inclined Press

Drum Feeds

Fig. 19 shows another style of dial feed in the form of a drum—a very simple mechanism, which presents advantages for feeding and ejecting fairly long pieces. The drum *A* is revolved by a modified Geneva intermittent motion, the drive of which is clearly shown. This mechanism is interesting in that it makes use of an unusual triangle drive to translate a rotary motion. Accuracy of location is obtained by the use of a pair of pilot pins in the press slide which enter bushings *B* in each die-plate.

In the case shown (one of a series of special machines for bolt-head trimming and such work), the feed is built right into the press; but it may also be built as a separate unit, and equipped, for instance, with a ratchet or friction grip drive. In such cases, presses of the adjustable bed type are especially adaptable on account of the high die space obtainable.

Indexing Feeds

Feeds designed to grip and advance or rotate strip, circular, cylindrical, or conical shaped work for a series of punching, notching, perforating, or stamping operations, equally spaced, usually require special treatment to suit the particular job. The same general principles apply in nearly every case, but owing to the variety of forms, specific applications are too numerous to discuss. They include, for instance, feeds for use in perforating cylindrical or conical shapes, armature disk notching, silver-plate decorating, flat perforating, etc.

The essential features common to most of these feeds are means of locating the work accurately; means of gripping it securely; feeding motion (usually a ratchet type, crank-driven); and a device to stop the press after the desired number of strokes. Also in most cases, there must be means of stopping the press at any time and, especially for flat work, a cam stripper to reduce distortion to a minimum. Convenience of arrangement and accuracy are essential to all feeds.

Fig. 18 shows a five-inch shaft press which runs at 120 strokes a minute and perforates up to forty odd square holes each stroke, in a variety of shapes and sizes of panels which require accurate gaging and indexing. The timing chart for the press and feed is shown at *M*, *N*, and *P* in Fig. 9 of the first installment. It will be noted that the stopping position of the press stroke is advanced, so that feeding is not begun until after the press starts, which facilitates gaging and setting up.

The feed is crank-driven and ratchet-operated, driving the racks by gears, which are split to permit taking up any backlash, and through a clutch to allow the feed drive to be disengaged. The controls are arranged for operation from either side of the machine. The two emergency stop-rods to the feed clutch and the press clutch extend across the front of the machine, and the handles for the gripper fingers and the racks are at the front on each side. The starting treadle extends the width of the machine with a guard above it. Adjustment and means of changing for different sizes are worked out for the greatest convenience and speed. The stop-strip mechanism at the side of the press includes a latch to prevent accidentally tripping the press when the feed is at the limit of its travel.

Indexing feeds in general are not adaptable to standardization, on account of the wide variation in the work to be handled and in the types of presses they are applied to. However, all have the same general characteristics of advancing and rotating the work a fixed amount for a predetermined number of strokes, and then stopping the press, and therefore make use of similar motions and devices.

Magazine Feeds

Magazine feeds, which in some cases are also called coin feeds and tube feeds, are a comparatively simple type, adapted to handling blanks of sufficient thickness to permit of being fed out positively from the bottom of a stack. They are also used in some cases for such stampings or forgings as can be stacked without danger of nesting or interlocking and are not so high as to be in danger of toppling over.

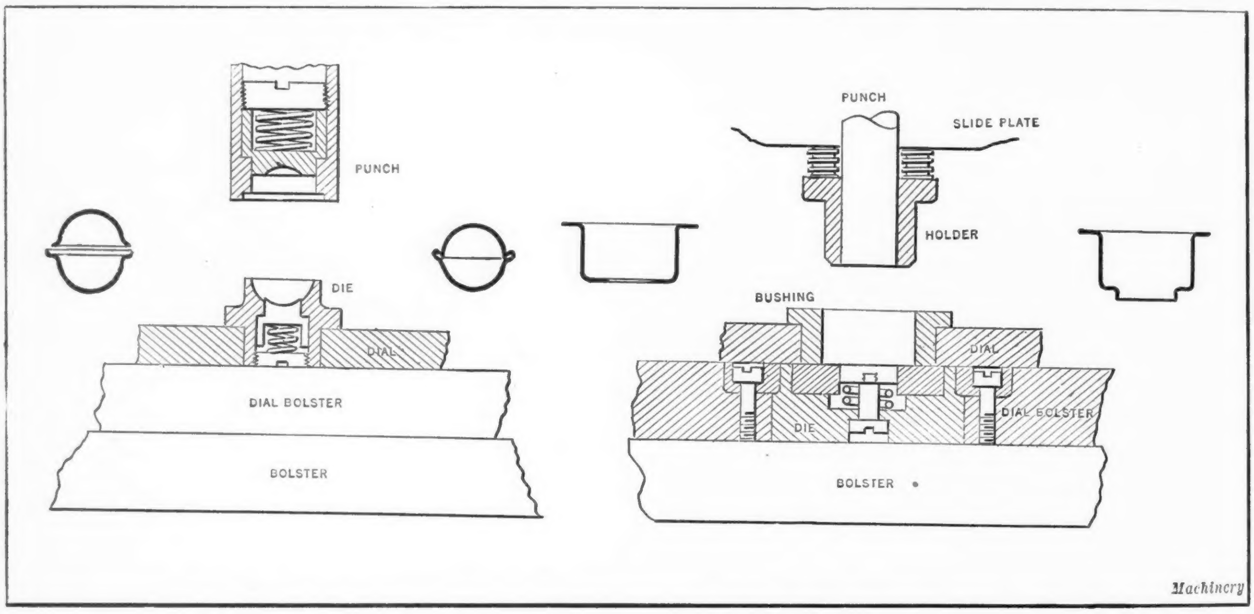


Fig. 23. Two General Classes of Station Dial Feeds

Fig. 20 shows a small feed of the magazine type quite clearly. The feed consists of a tube or magazine which serves as a container and guide for the stack of parts to be worked, and a reciprocating slide driven from the press shaft. The reciprocating slide projects above the guide from magazine to die by slightly less than the thickness of a blank, and the magazine clears the guide by slightly more than the thickness of one blank; therefore, as the slide moves forward, it carries one blank from the bottom of the stack to the die, and as it moves back, the stack drops one blank lower. The magazine can be arranged to take blanks of almost any shape, although regular circles and rectangles are the most common, on account of complications in feeding and placing irregular shapes.

This type of feed can usually be built as an entirely self-contained unit, which may be bolted to the press bolster. It may be placed either at the front or the side of the press, and can be applied to practically any type of press. Placing the feed at the side is usually the most satisfactory for end-wheel type gap-frame presses, on account of the drive, but for the side-wheel type presses, it may be mounted either at the front or the side, according to the conditions of the individual case. Adjustment can be provided on the driving

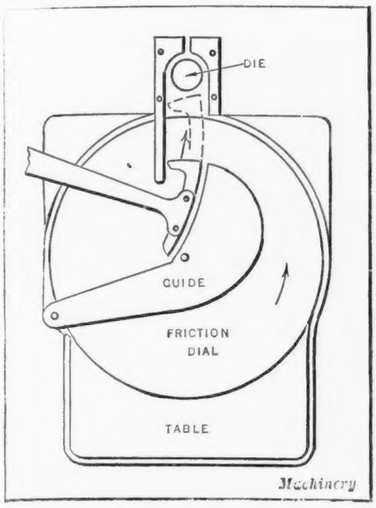


Fig. 24. Plan of Typical Friction Dial Feed

crankpin to alter the length of the feed stroke, but as this is rarely necessary, a fixed crankpin is more usual.

Magazine feeds for press work are used particularly in connection with coining, swaging, piercing, and forming operations, and on some stamping and repunching work. These feeds are sometimes used in connection with hopper feeds, which are rather complicated. Another modification includes the use of gripper fingers on the reciprocating slide, in which case the blank is dropped into the die centrally, instead of being pushed into it. It is often possible, when magazine feeds are being used, to utilize some sort of stacking device under the press, to receive the blanks and facilitate feeding.

Pneumatic "Suction" Feeds

Such blank feeds and suction strip feeds function similarly to the magazine feeds in that they handle blanks or strips automatically from stacks to reciprocating feed fingers. They are adapted to handling comparatively large-area light-gage material such as the tin plate used in can making.

Large-area blanks can be lifted from the top of a stack and carried into position, but here the mechanism involved is too complicated for any but highly developed processes. A feed of this type forms a part of the equipment of automatic can-end presses, such as the one illustrated in Fig. 21. Short strips may be fed from the bottom of a stack, as on automatic can-body making machines, but here a certain stiffness and spring in the blank is required, and the blanks must be very accurately and cleanly cut.

Gravity Chute Feeds

Gravity chute feeds are comparatively simple, consisting only of a chute of proper dimensions, down which the work moves by gravity, and a releasing device to drop one piece at a time into the die, with sometimes the addition of a mechanism to gage and hold the shell in the proper position. The presses are usually used either in the horizontal position on special legs or inclined back 45 degrees or more from the vertical. Fig. 22 illustrates a chute feed on a press in the inclined position. This method of feeding is limited to parts that can be put into a chute without danger of becoming twisted or of overlapping. Gravity chute feeds are also used on automatic machines for rolling beads and threads, or similar work.

Conveyor Type Feeds

Feeds arranged with endless belts or chains are used occasionally for feeding comparatively large sheets of tin plate, paper, etc., and for other special work. They usually involve the use of tables on the front and back of the press. The sheet passes from the front through the dies with an intermittent motion, and the scrap is delivered at the back. Very accurate feeds of this type have been built, with flexible spring steel conveyor bands and a ratchet drive, for gang die work in blanking or blanking and forming bottle caps and small wrappers from lithographed sheets. These feeds are used, as a rule, with presses of the double-crank type, and as the development cost is rather high where extreme accuracy is required, they are used only when very high production warrants them. Fig. 14 illustrates a continuous conveyor feed of the band type for punching from large sheets. It is equipped with a skip motion to prevent cutting half blanks at the beginning and end of sheets.

Hopper Feeds

On some classes of work, where small partially worked symmetrical parts are fed in large quantities to fast presses, hopper feeds are advisable. They include a hopper, or receiver, in which the pieces are agitated, and those that fall in the right position are passed on, timed, and carried by some one of the simpler feed motions into the die. Hopper feeds for screw blanks or parts that can be picked up by the head, are more or less standardized, and are quite well known. Hopper feeds for press work, however, present a more serious problem, on account of irregularities in the parts and the dangers of injury, jamming, and misfeeding. The development cost is necessarily high, as each feed presents a problem in itself, and frequently requires some novel solution.

There are a few general types of hopper feeds that are more or less well known. The pin type, adapted to feeding small redrawn shells which are considerably greater in length than in diameter, consists essentially of a disk, having a series of pins located nearly tangentially about its periphery, which rotates in a vertical plane in an agitated receiver full of shells. Some of the shells are picked up on the pins and delivered by them to a tube which carries them to some dial or reciprocating feed and thence to the dies. As picking up the shells is somewhat a matter of chance, provision must be made, when too many are started, to relieve congestion without letting any of the shells be turned over.

Another type of feed for similar shaped pieces makes use of an agitated hopper to start the shells, either top or bottom up, down an inclined tube, at the end of which is a protruding finger on the axis of the tube and in a chamber allowing space enough so that shells coming open end first catch on the pin and are turned over while those coming bottom first just slide off and continue. The problem here is positiveness and control over feeding and clogging in the tube.

Another general type of hopper feed is adapted to feeding shells materially less in height than in diameter. Here agitation and gravity are employed to keep them flat, and then those that are right side up may be mechanically selected; the excess is gotten rid of, and the remainder delivered by a reciprocating feed to the die.

A third class of hopper feed is adapted to handling coin-shaped slugs or blanks. It may consist, for instance, of a selector plate, in the bottom of a conical hopper, having a spiral-shaped groove the depth and width of the slug. This selector, in conjunction with a reciprocating finger, delivers one slug at a time to the chute, and thence by reciprocating feed, to the die.

Other types of hopper feeds with many ingenious motions and devices have been developed to suit different cases. It will be noted, however, that all depend to some extent at some point upon chance, though the final result must be positive and reliable. All confront the problem of jamming in the hopper, on account of the quantity and weight of parts, or further on, due to possible over-feeding, and each one is suited to just one size and shape of shell. Considerable experimenting is required in nearly every case before uniform and reliable feeding is obtained.

Combination of Feeds

It is possible in some cases, and essential in others, to combine different feeds of the simpler types for handling special jobs. Multiple-slide presses, for instance, require reciprocating feeds across the dies, with, as a rule, a friction dial feed or a roll feed to start the work. In general, however, it is more advisable to use the simpler and more or less universal feeds. It is with them that the real economies of mechanical feeding are obtained.

* * *

The Bureau of Standards has made an investigation into the holding power of wood screws in different kinds of wood. The results of the investigation are described in a booklet just issued by the bureau, copies of which may be obtained from the Government Printing Office, Washington, D. C. The price is 5 cents.

Change-gears for Spiral Gear Hobbing

Table for Rapid Computation of Change-gears and Example Illustrating Application

By JOHN M. CHRISTMAN

THE method outlined in this article, besides being very rapid, may be used in computing change-gears that produce exceptionally accurate leads. A variation of only 0.0001 inch to 1 inch of the lead is easily obtained. (This table is not intended for machines equipped with a differential.) There are two sets of change-gears on gear-hobbing machines. The gears that control the indexing are called "index gears," and those that control the feed are called "feed gears." These change-gears should be within the limits of 20 and 100 teeth.

If the feed gears are computed first and index gears are then computed to suit this set of feed gears, a variation in the index gears of one tenth of 1 per cent will cause about 20 per cent variation in the lead of the gear being cut. In fact, often, after computing the closest possible set of index gears to go with the feed gears, the variation in the lead will be too great for practical purposes. If the index gears are computed first and feed gears are then computed to suit this set of index gears, a variation in the feed gears of one-tenth of 1 per cent will cause only one-tenth of 1 per cent variation in the lead of the gear being cut. Usually, there are more than 100 different sets of feed gears to suit one set of index gears, and by using any one of these sets the desired lead may be cut well within the limit for practical purposes.

The writer conceived the idea of compiling a small table which would give the approximate index gears almost at once, and from which the corresponding feed gears could easily be obtained. After a rather complicated mathematical analysis, the accompanying table was made. To show how this table is applied, assume that a gear is to be cut having 54 teeth, 10 pitch, and a right-hand spiral of 27.3272 inches lead. This gear is to be cut with a left-hand single-thread hob, using a 0.020 inch feed. Also assume that when the index gears all have the same number of teeth, the machine will cut 30 teeth (the machine ratio), and when the feed gears all have the same number of teeth, the machine will feed 1/12 inch.

The lead 27.3272 divided by the feed 0.020 equals approximately 1366. The closest number to 1366 listed in column X of the right-hand section of the table is 1364, and in column $\frac{A \times C}{B \times D}$ is listed $\frac{44 \times 62}{91 \times 30}$. This group of factors multiplied by $\frac{R}{N}$, in which R is the machine ratio and N the number of teeth in the gear to be cut, gives the index gears. Thus:

$$\frac{44 \times 62}{91 \times 30} \times \frac{R}{N} = \frac{44 \times 62}{91 \times 30} \times \frac{30}{54} = \frac{44 \times 62 \text{ driving}}{91 \times 54 \text{ driven}}$$

In almost every group of factors listed in the table, D equals 30. Since ratio R on nearly all machines is 15, 30, or 60, R and 30 readily cancel, so that index gears are obtained without any trouble. If R has a different value, it would be better to make a table to suit the value of R.

The lead is divided by the number listed in column X to obtain the feed to be used with the index gears. Thus:

$$\frac{27.3272}{1364} = 0.0200346 \text{ inch}$$

Since the feed of the machine is 1/12 when the feed gears have the same number of teeth, the ratio of the feed gears is $\frac{1/12}{0.0200346}$, or 4.15947. Feed gears for the ratio 4.15947 can be obtained by the process of continued fractions or by the following method, which is easier to explain and does the work quickly, with very close results. To apply this method, write the ratio in terms of 1000; thus, $4.15947 = \frac{4159.47}{1000}$. Then place the numerator and denominator at each side of a vertical line, as shown below, subtract 1/100 of each number from itself, and try to factor the remainders, disregarding the decimal part of the number.

1000 10	4159.47 41.59	$\frac{4160}{1000} = \frac{64 \times 65 \text{ driven}}{40 \times 25 \text{ driving}}$	27.3237 lead
990 10	4117.88 41.59	$\frac{4118}{990} = \frac{58 \times 71 \text{ driven}}{30 \times 33 \text{ driving}}$	27.3264 lead
980 10	4076.29* 41.59		
970 10	4034.70* 41.59	Note: Numbers marked with asterisk (*) cannot be factored.	
960 10	3993.11* 41.59		
950 10	3951.52 41.59	$\frac{3952}{950} = \frac{52 \times 76 \text{ driven}}{38 \times 25 \text{ driving}}$	27.3237 lead
940 10	3909.93 41.59	$\frac{3910}{940} = \frac{46 \times 85 \text{ driven}}{47 \times 20 \text{ driving}}$	27.3265 lead
930 10	3868.34 41.59	$\frac{3869}{930} = \frac{53 \times 73 \text{ driven}}{31 \times 30 \text{ driving}}$	27.3226 lead
920	3826.75	$\frac{3827}{920} = \frac{43 \times 89 \text{ driven}}{23 \times 40 \text{ driving}}$	27.3251 lead

The first set of feed gears calculated would be close enough for practical purposes, since the lead variation is only 0.0035 inch, but six sets were computed to demonstrate the method. In the column headed 1000, it should be noted that by subtracting 10 each time, the remainders can always be factored. This is the reason for expressing the ratio in terms of 1000.

To find the lead the feed gears will cut when used with the index gears, multiply the number obtained from column X by the even gear feed of the machine, and then multiply by the ratio of the feed gears. Thus:

$$1364 \times \frac{1}{12} \times \frac{40 \times 25 \text{ driving}}{64 \times 65 \text{ driven}} = 27.3237 \text{ inches lead}$$

It is advisable always to make this simple check, as a proof that the solution is correct.

This method of computing change-gears is being used by a number of people interested in gears, and they claim that it is better than any method they know of. Gears for both index and feed can be computed in about ten minutes.

If there is not a complete set of index gears at hand, it is advisable to try several of the X numbers and use the group of factors that correspond to the gears on hand. If the X numbers vary too much from the number obtained by dividing the lead by the feed, the feed will be too great or too small. In like manner, different sets of feed gears can be computed, and the set used that corresponds with the gears on hand.

By multiplying or dividing both the numerator and the denominator of the gear ratios by the same number, different sets of gears can, of course, be obtained without chang-

ing the gear ratio. For example, any of the following groups have the same value:

$$\frac{64 \times 65}{40 \times 25} = \frac{32 \times 65}{20 \times 25} = \frac{96 \times 65}{60 \times 25} = \frac{48 \times 78}{30 \times 30} = \frac{96 \times 91}{84 \times 25}, \text{ etc.}$$

In order to prove that results are far closer if the feed gears are computed to suit the index gears, the writer computed the two closest sets of feed gears to be used with the index gears and the following leads were obtained:

$$\frac{1364}{1} \times \frac{1}{12} \times \frac{37 \times 20}{54 \times 57} = 27.32727 \text{ inches lead}$$

The variation in this case is 0.00007 inch.

$$\frac{1364}{1} \times \frac{1}{12} \times \frac{34 \times 45}{86 \times 74} = 27.32715 \text{ inches lead}$$

The variation in this case is 0.00005 inch.

If the index gears are computed to suit the feed gears, the two closest sets of index gears, which are $\frac{62 \times 66}{35 \times 65}$ and $\frac{52 \times 100}{49 \times 59}$, will produce the following leads:

TABLE USED IN COMPUTING CHANGE-GEARS FOR SPIRAL GEAR HOBBING

GEAR AND HOB OF LIKE "HANDS" Right-hand gear and right-hand hob Left-hand gear and left-hand hob						GEAR AND HOB OF UNLIKE "HANDS" Right-hand gear and left-hand hob Left-hand gear and right-hand hob					
X	$\frac{A \times C}{B \times D}$	X	$\frac{A \times C}{B \times D}$	X	$\frac{A \times C}{B \times D}$	X	$\frac{A \times C}{B \times D}$	X	$\frac{A \times C}{B \times D}$	X	$\frac{A \times C}{B \times D}$
25	$\frac{5 \times 25}{4 \times 30}$	133	$\frac{19 \times 35}{22 \times 30}$	826	$\frac{28 \times 59}{55 \times 30}$	24	$\frac{12 \times 12}{5 \times 30}$	129	$\frac{9 \times 43}{13 \times 30}$	729	$\frac{27 \times 81}{73 \times 30}$
28	$\frac{10 \times 28}{9 \times 30}$	145	$\frac{25 \times 29}{24 \times 30}$	901	$\frac{17 \times 53}{30 \times 30}$	26	$\frac{10 \times 26}{9 \times 30}$	134	$\frac{4 \times 67}{9 \times 30}$	799	$\frac{47 \times 51}{80 \times 30}$
31	$\frac{1 \times 31}{1 \times 30}$	154	$\frac{28 \times 55}{51 \times 30}$	961	$\frac{31 \times 93}{96 \times 30}$	29	$\frac{3 \times 29}{3 \times 30}$	143	$\frac{13 \times 55}{24 \times 30}$	869	$\frac{11 \times 79}{29 \times 30}$
34	$\frac{10 \times 34}{11 \times 30}$	171	$\frac{19 \times 27}{17 \times 30}$	1066	$\frac{41 \times 52}{71 \times 30}$	32	$\frac{10 \times 32}{11 \times 30}$	155	$\frac{25 \times 31}{26 \times 30}$	949	$\frac{39 \times 73}{95 \times 30}$
37	$\frac{5 \times 37}{6 \times 30}$	186	$\frac{31 \times 36}{37 \times 30}$	1276	$\frac{44 \times 58}{85 \times 30}$	35	$\frac{5 \times 35}{6 \times 30}$	169	$\frac{13 \times 39}{17 \times 30}$	1034	$\frac{44 \times 47}{69 \times 30}$
41	$\frac{3 \times 41}{4 \times 30}$	201	$\frac{9 \times 67}{20 \times 30}$	1411	$\frac{34 \times 83}{94 \times 30}$	39	$\frac{3 \times 39}{4 \times 30}$	185	$\frac{25 \times 37}{31 \times 30}$	1139	$\frac{17 \times 67}{38 \times 30}$
43	$\frac{5 \times 43}{7 \times 30}$	221	$\frac{17 \times 39}{22 \times 30}$	1501	$\frac{38 \times 79}{100 \times 30}$	41	$\frac{5 \times 41}{7 \times 30}$	203	$\frac{29 \times 35}{34 \times 30}$	1274	$\frac{49 \times 52}{85 \times 30}$
46	$\frac{2 \times 46}{3 \times 30}$	247	$\frac{19 \times 65}{41 \times 30}$	1681	$\frac{41 \times 41}{56 \times 30}$	44	$\frac{2 \times 44}{3 \times 30}$	221	$\frac{17 \times 65}{37 \times 30}$	1364	$\frac{44 \times 62}{91 \times 30}$
49	$\frac{5 \times 49}{8 \times 30}$	265	$\frac{25 \times 53}{44 \times 30}$	1891	$\frac{31 \times 61}{63 \times 30}$	49	$\frac{3 \times 49}{5 \times 30}$	245	$\frac{35 \times 35}{41 \times 30}$	1484	$\frac{53 \times 56}{99 \times 30}$
55	$\frac{5 \times 55}{9 \times 30}$	291	$\frac{9 \times 97}{29 \times 30}$	2401	$\frac{49 \times 49}{80 \times 30}$	53	$\frac{5 \times 53}{9 \times 30}$	259	$\frac{21 \times 37}{26 \times 30}$	1649	$\frac{17 \times 97}{55 \times 30}$
61	$\frac{1 \times 61}{2 \times 30}$	319	$\frac{29 \times 55}{53 \times 30}$	2581	$\frac{29 \times 89}{86 \times 30}$	59	$\frac{1 \times 59}{2 \times 30}$	284	$\frac{16 \times 71}{38 \times 30}$	1829	$\frac{31 \times 59}{61 \times 30}$
67	$\frac{5 \times 67}{11 \times 30}$	351	$\frac{27 \times 39}{35 \times 30}$	2821	$\frac{31 \times 91}{94 \times 30}$	65	$\frac{5 \times 65}{11 \times 30}$	319	$\frac{29 \times 33}{32 \times 30}$	2009	$\frac{41 \times 49}{67 \times 30}$
73	$\frac{5 \times 73}{12 \times 30}$	385	$\frac{35 \times 55}{64 \times 30}$	2911	$\frac{41 \times 71}{97 \times 30}$	71	$\frac{5 \times 71}{12 \times 30}$	344	$\frac{16 \times 43}{23 \times 30}$	2279	$\frac{43 \times 53}{76 \times 30}$
79	$\frac{5 \times 79}{13 \times 30}$	427	$\frac{35 \times 61}{71 \times 30}$	3481	$\frac{59 \times 59}{58 \times 60}$	77	$\frac{5 \times 77}{13 \times 30}$	377	$\frac{29 \times 65}{63 \times 30}$	2639	$\frac{29 \times 91}{88 \times 30}$
85	$\frac{5 \times 85}{14 \times 30}$	469	$\frac{35 \times 67}{78 \times 30}$	3721	$\frac{61 \times 61}{62 \times 60}$	83	$\frac{5 \times 83}{14 \times 30}$	413	$\frac{35 \times 59}{69 \times 30}$	2849	$\frac{37 \times 77}{95 \times 30}$
91	$\frac{7 \times 13}{3 \times 30}$	517	$\frac{47 \times 55}{86 \times 30}$	3901	$\frac{47 \times 83}{65 \times 60}$	89	$\frac{2 \times 89}{6 \times 30}$	455	$\frac{35 \times 65}{76 \times 30}$	3239	$\frac{41 \times 79}{54 \times 60}$
97	$\frac{5 \times 97}{16 \times 30}$	561	$\frac{33 \times 51}{56 \times 30}$	4081	$\frac{53 \times 77}{68 \times 60}$	95	$\frac{5 \times 95}{16 \times 30}$	497	$\frac{35 \times 71}{83 \times 30}$	3479	$\frac{49 \times 71}{58 \times 60}$
106	$\frac{4 \times 53}{7 \times 30}$	621	$\frac{27 \times 69}{62 \times 30}$	5041	$\frac{71 \times 71}{84 \times 60}$	104	$\frac{13 \times 16}{7 \times 30}$	549	$\frac{27 \times 61}{55 \times 30}$	3599	$\frac{59 \times 61}{60 \times 60}$
111	$\frac{9 \times 37}{11 \times 30}$	676	$\frac{26 \times 52}{45 \times 30}$	——	——	110	$\frac{20 \times 55}{37 \times 30}$	609	$\frac{29 \times 63}{61 \times 30}$	4559	$\frac{47 \times 97}{76 \times 60}$
121	$\frac{11 \times 11}{4 \times 30}$	741	$\frac{39 \times 57}{74 \times 30}$	——	——	119	$\frac{17 \times 35}{20 \times 30}$	679	$\frac{21 \times 97}{68 \times 30}$	5159	$\frac{67 \times 77}{86 \times 60}$

Machinery

$$\frac{0.020 \times 62 \times 66 \times 30}{(35 \times 65 \times 54) - (62 \times 66 \times 30)} = 27.28 \text{ inches lead; va-}$$
riation, 0.047 inch

$$\frac{0.020 \times 52 \times 100 \times 30}{(49 \times 59 \times 54) - (52 \times 100 \times 30)} = 27.368 \text{ inches lead;}$$
variation, 0.041 inch

The variation in the latter case is excessive, and could not be used when accurate work is required.

If the spiral gear lead is not given, it can be obtained from the following formula, in which D.P. = diametral pitch; θ = angle of spiral; and N = number of teeth:

$$\text{Lead} = \frac{3.1416 \times N}{\text{D.P.} \times \sin \theta}$$

* * *

RADIUS MILLING FIXTURE FOR GEAR SECTOR

By ALBERT A. DOWD

The details of a large cast-iron gear sector, for which rapid-production equipment was required, are shown in Fig. 1. The first operations performed on the sector are drilling and reaming the holes in the bosses *A* and *B*, and spot-facing the four ends of the bosses. It was a simple matter to provide efficient equipment for these operations, but the making of a suitable fixture for milling the surfaces *C*, *D*, and *E* with a gang cutter presented a more difficult problem. The fixture finally built for this work is shown in Fig. 2. This was used on a vertical-spindle milling machine.

The fixture consists primarily of a base *E* secured to the milling machine table, a dovetail slide *F* on which the work is clamped, and a radius bar *G*, the outer end of which pivots on a stud *H* on bracket *S*, which is secured to the knee. The inner end of bar *G* is connected to slide *F* by stud *I*. As stud *I* necessarily follows the path or arc of a circle having a radius *J*, when the table feed is engaged, the member *F* is caused to slide in the base *E*.

Referring to the illustration, it will be clear that when the feeding movement of the table carries stud *I* to either side

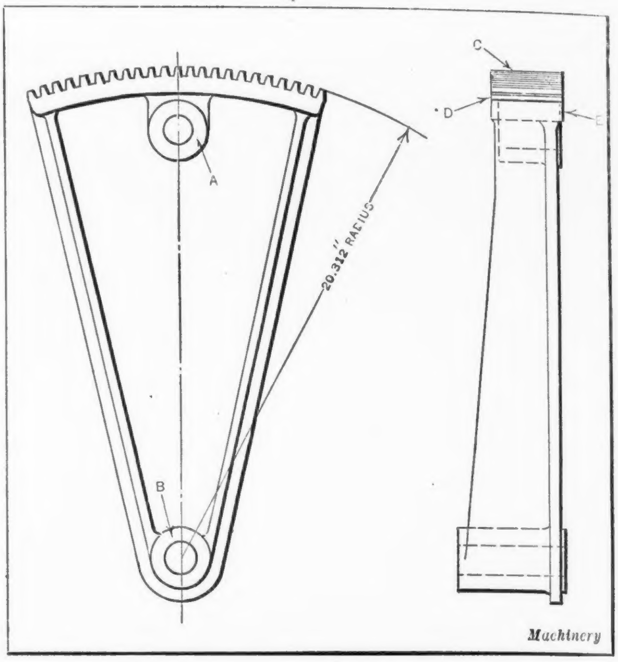


Fig. 1. Gear Sector which requires Radius Milling Operation

of the center line *X–X*, slide *F* will be carried in toward the cutter. Thus when the table feed is engaged and the work fed past the cutters, which remain in a fixed position on line *X–X*, the middle cutter *K* will machine the outer surface *C* to the required radius, as a result of the combined cross and longitudinal movements of the slide *F*. Before starting a cut, the table is fed over the extreme right-hand position, so that the cut is started at the end *L* of the sector.

The work is held in place by C-washers and nuts on studs that pass through the drilled and reamed holes *A* and *B*, and by the compensating clamps *N*. These clamps are constructed as shown by the enlarged view in the lower right-hand corner of Fig. 2. The hook-bolt *P* is a sliding fit in the clamp *N*, which, in turn, is a sliding fit in the slide *F*. The hook end of bolt *P* engages a notch in the clamping pin *R*. Clamps *N* can be swung around to permit the work to be put in place.

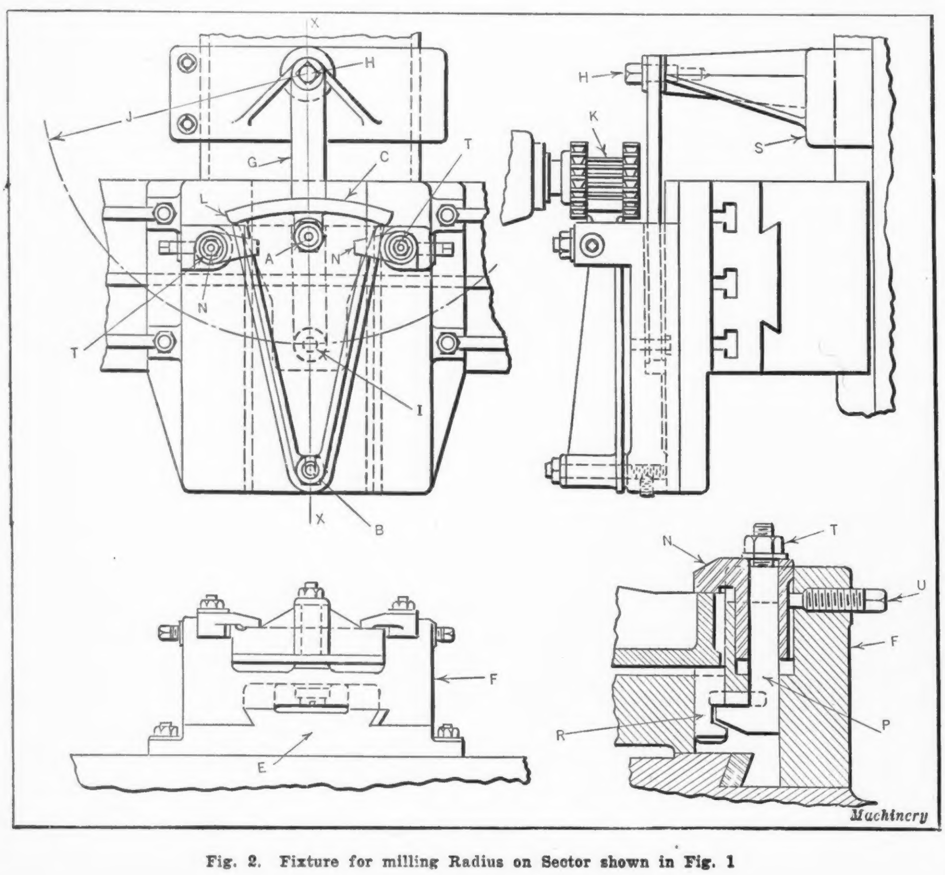


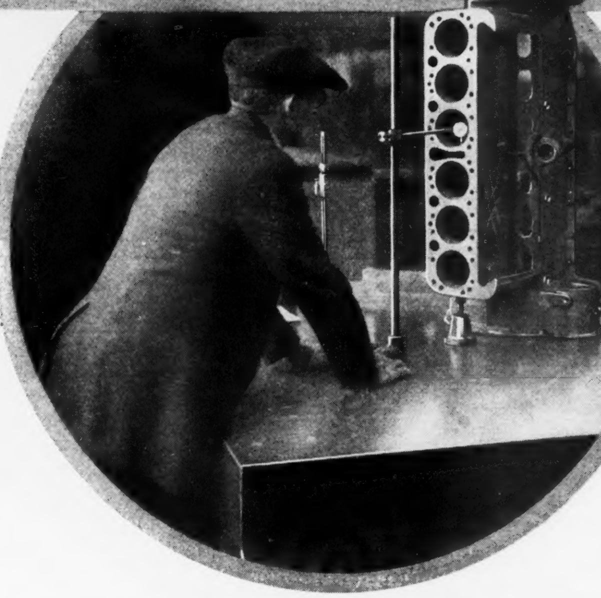
Fig. 2. Fixture for milling Radius on Sector shown in Fig. 1

The work is first clamped down by tightening the nuts on the two studs that pass through the holes *A* and *B*. When thus located, the nuts *T* on bolts *P* are tightened, causing the work to be gripped on the rough surfaces between the clamping members *N* and *R* without distorting the casting. The compensating clamps are then locked in position by tightening the set-screws *U* on the flats machined on clamps *N*.

* * *

The sales of copies of the Simplified Practice Recommendations developed by the Simplified Practice Division of the Department of Commerce, in cooperation with numerous industries, has reached the quarter of a million mark. The recommendations are bought by manufacturers for their sales and engineering offices, by trade associations for their membership, and by manufacturers and distributors for their salesmen in the field, to keep them in touch with the latest developments.

Inspection Devices in an Automobile Plant



Second of Two Articles Describing Interesting Examples of Gaging Equipment Used in One of the Nash Plants

VARIOUS examples of gaging devices used in the Kenosha, Wis., plant of the Nash Motors Co. were described in an article published in November MACHINERY. This article will show further examples, each of which has some unusual feature of construction. In Fig. 1 is shown a sine bar fixture in which the sine bar *A* may be adjusted close amounts angularly without disturbing the vertical position of part *E* about which the bar swivels. Also, the bar may be adjusted vertically without changing the angle at which it is inclined.

In using this device, bar *A* is set to the approximate angle and height required, and then closely adjusted by the means provided. To quickly move the bar unit vertically, a clamping nut on the back of the column is released, and button *B* of collar *C* is depressed, releasing a split nut from the finely threaded screw *D*. The bar unit can then be freely slid up and down. In making a close vertical adjustment, the split nut in collar *C* is permitted to grip the thread of the lead-screw, and then as the collar is revolved, the bar unit is moved vertically only 0.025 inch per revolution of the collar. Approximate angular adjustments are made by swiveling bar *A* and part *E* together by hand, while minute angular adjustments of the bar are accomplished by loosening and tightening, as required, two opposing screws *F* (only one of which can be seen in the illustration). These screws enter tapped holes in the lugs of part *E* and bear against an extension of the part attached to lead-screw *D*. Both angular and vertical positions of the sine bar can be retained by means of clamping nuts at the rear of the column.

Number of Shims Required in a Roller Bearing Installation

A device used for determining the number of shims required to obtain the correct adjustment of the clutch shaft roller bearing in the transmission case is shown in Figs. 2 and 3. High and low limits are specified on various surfaces of the parts to be assembled, and consequently, the number of shims usually varies with each unit. This will be apparent from Fig. 2, where it will be seen that the roller bearing *A* must seat on surface *B* of the shaft and the bearing cage *C* must seat on the bearing. Hence, the longitudinal position of the bearing cage *C* on the clutch shaft varies because of small differences in the dimensions of the parts mentioned, and the cage must be backed up with enough shims *D* to compensate.

With the roller bearing and cage on the shaft, the latter is placed in the fixture so that the clutch gear face rests on the hardened block *E*, Fig. 3, and the flange of the bearing cage *C* rests on a large collar *F*, which is backed up by a number of coil springs. Then the cage and collar *F* are pushed down together until the roller bearing seats firmly on the shaft and the cage rests firmly on the roller bearing. By referring to the dial indicator *G*, the number of shims required for the particular unit can easily be determined, the indicator being graduated to 0.001 inch. The mechanism

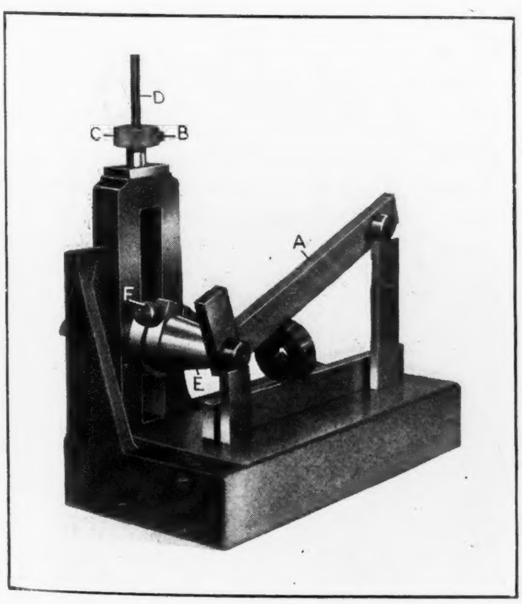


Fig. 1. Sine Bar Fixture in which the Sine Bar can be adjusted vertically without disturbing the Angular Setting

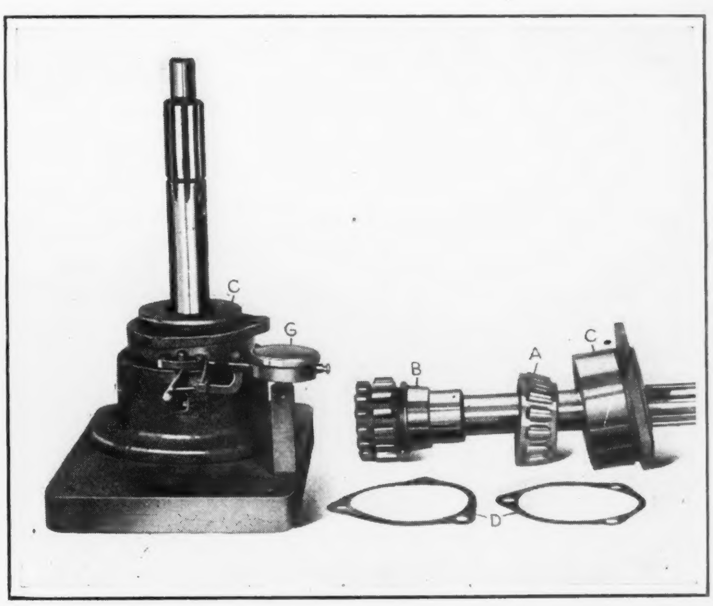


Fig. 2. Device used for determining Number of Shims required in assembling Tapered Roller Bearing on Clutch Shaft

for actuating the indicator needle from collar F differs somewhat in the two illustrations, that shown in Fig. 2 being the construction actually in use.

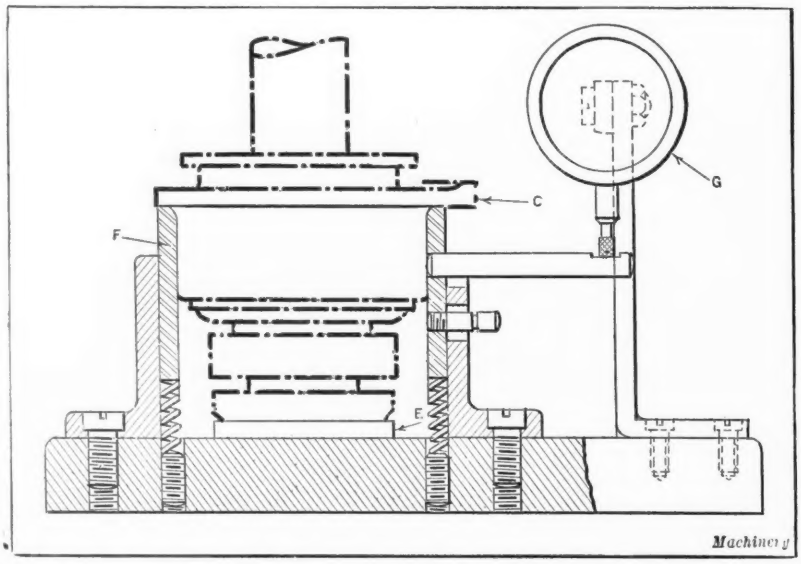


Fig. 3. Cross-sectional View of the Fixture illustrated in Fig. 2

Inspecting Gear-shifter Rods and Conical Ended Pins

Gear-shifter rods are made with three notches at one end, as shown at A in Fig. 4, and one notch diametrically opposite these notches but at the other end of the rod. It is necessary to closely inspect the longitudinal distance between one of the three notches and the notch at the opposite end, and this is accomplished by means of the fixture shown at the left in the illustration. As shown at B, the rod is laid on two hardened and ground blocks, with one notch engaging the stationary plug C. The notch at the opposite end is pushed against a lever D, which is rounded to suit the notch. When the rod is pushed against it, the lever swivels in a horizontal plane to suit the location of the notch, and as the contact point of the dial indicator E bears against the back end of lever D, the amount and direction of any error in the length between the two notches of the rod can readily be determined from the indicator.

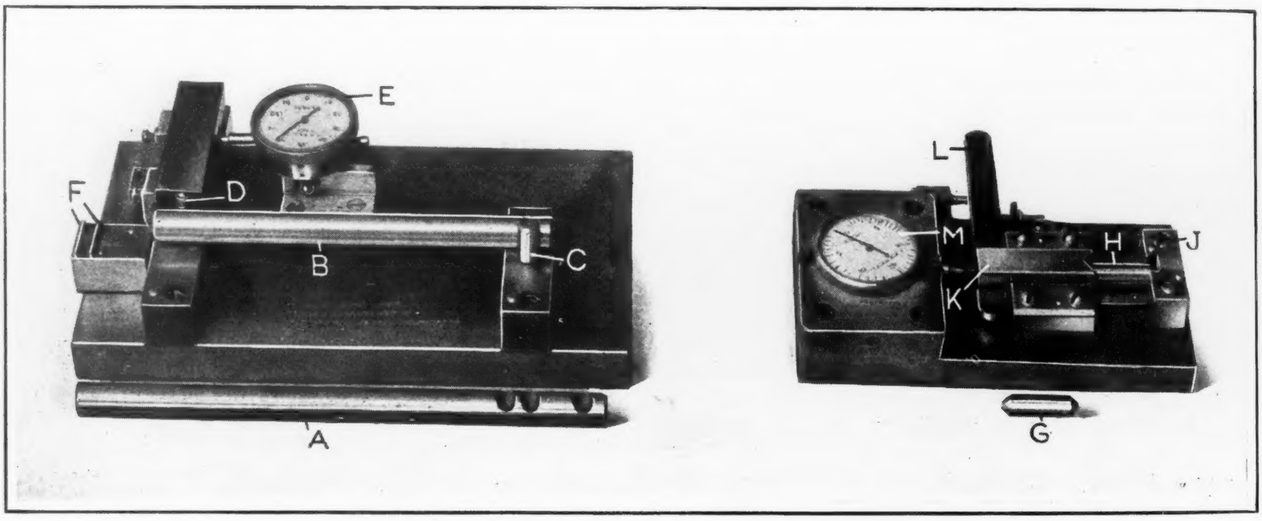


Fig. 4. Two Fixtures equipped with Indicator Dials for inspecting Lengths of Parts

The distance between the center of one notch and the end of the rod is checked by observing whether or not the end rests on one of ridges F of a block at the left-hand end of the fixture, when the notch at the other end of the rod is engaged with plug C. The widths of ridges F represent the high and low limits specified on the length of the rod. In the illustration, rod B is a master for the gage and thus does not extend to the block containing ridges F.

At G in the same illustration is shown a small pin ground almost to a cone at both ends. It is necessary to check the distance from each tapered surface of the ends to the small flat area of the opposite end, and this is accomplished by means of the gaging fixture shown directly above the pin. The inspection is performed by placing the pin in the fixture, as shown at H, between the stationary block J and the movable block K. Block J is flat where the pin comes in contact with it, while in block K the tapered end of the pin enters a V-groove. Block K is drawn toward the left by means of handle L to permit placing the work between the two blocks, and when the handle is released, the block K is pushed firmly against the work by spring pressure. The spring is contained within block K. The contact point of indicator M bears against block K, and consequently, gives different readings for different pin lengths. When pins are made to the nominal length, the dial needle registers zero, and any error in the pin length, as well as the direction of the error, is indicated by the deviation of the needle from the zero graduation. Stop-screws limit the movement of handle L. This is another example where the pressure on the indicator spindle is reduced instead of increased after the work is placed in the fixture.

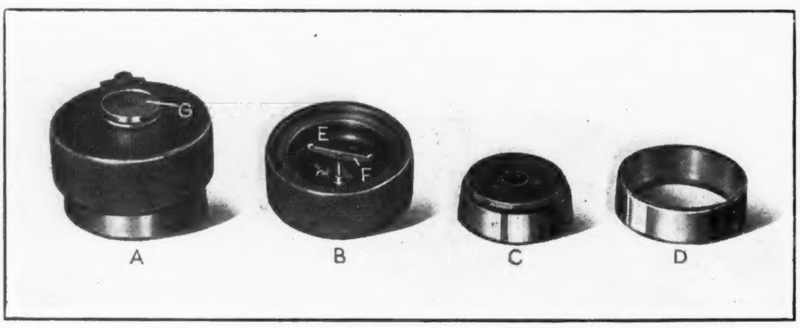


Fig. 5. Indicator used for checking the Internal Tapered Surface of Roller Bearing Cups

Gages for Inspecting Internal and External Tapered Surfaces

At A in Fig. 5 is shown a gage used in checking the size of the internal tapered surface of roller bearing cups, such as shown at D. In an inspection, the

cup is slipped over base C, which is tapered to suit, and then the gage is placed on top of the cup. From view B, which shows the bottom of a gage, it will be seen that there is an inner ring E, which is attached to the gage housing, and a double-ended lever F which is connected to the dial indicator G. When the gage is laid on the cup, with the cup on base C, ring E rests on the upper edge of the cup, and feelers F come in contact with the top of base C. It will be obvious that the larger the tapered internal surface of cup D, the farther down the cup will rest on the base, and the smaller the cup, the higher it will rest on the base. For each variation of 0.001 inch from the nominal diameter of the tapered surface, the indicator registers from 0.005 to 0.007 inch, depending upon the angle of the tapered surface.

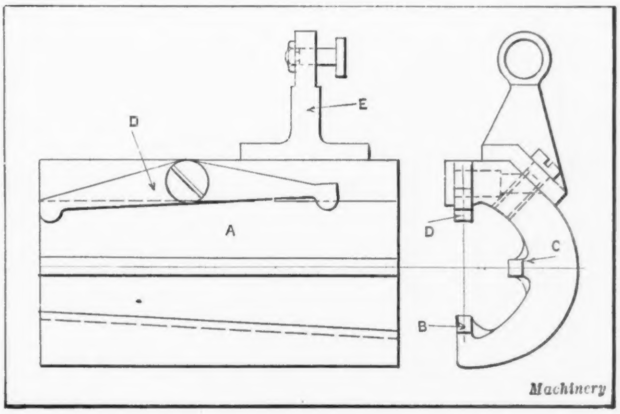


Fig. 6. Simple Indicator used in gaging the Tapered Surface of Rear Axle Drive Shafts

Use is made of the gage shown in Fig. 6 for checking the angle of a tapered surface on the rear-axle drive shaft. The gage consists essentially of a tool-steel holder A which has two integral keys B and C running the entire length of the holder and tapered to suit the surface being inspected. There is also a hinged lever D directly opposite key B, which has two rounded ends, the back of the right-hand one normally engaging the contact point of a dial indicator fastened to bracket E. In an inspection, the gage is slipped on the tapered surface until the hinged lever tightens firmly on the work, at which time the reading of the dial indicator is observed. The indicator dial is set to zero by means of a master, and when parts are being inspected, the indicator needle must not vary more than plus or minus 0.0005 inch from the zero graduation. The gage has been in constant service over 2 1/2 years and has not worn appreciably.

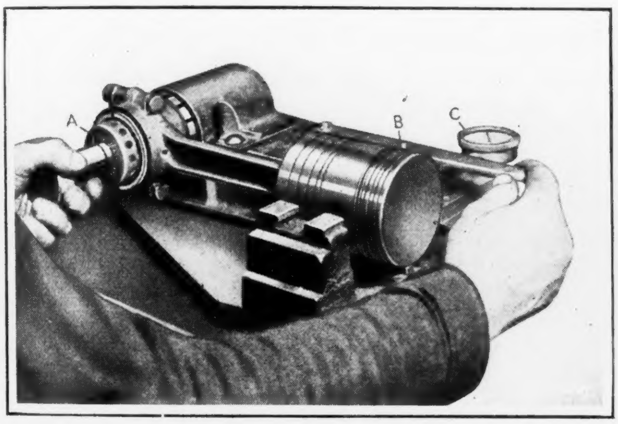


Fig. 7. Inspecting the Squareness of a Piston Wall Relative to the Crank Bearing of the Connecting-rod

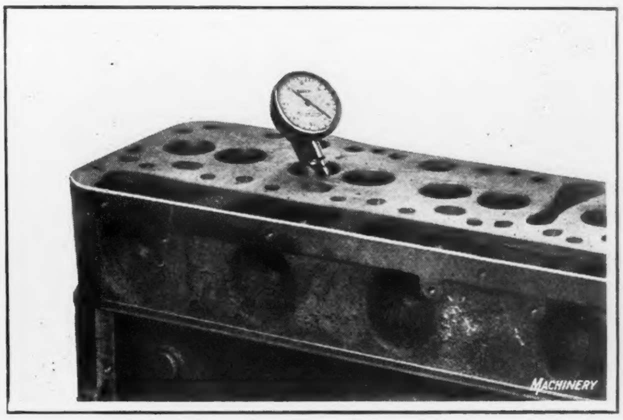


Fig. 8. Inspecting the Concentricity of Valve Seats in the Cylinder Head Relative to the Valve Rod Guide Holes

Testing the Squareness of Piston Walls with Connecting-rod Crank Bearings

The squareness of the piston wall with the crank bearing of the connecting-rod to which the piston is assembled is checked by means of the device illustrated in Fig. 7. The crank bearing is slipped over an arbor A, which is then expanded to hold the connecting-rod firmly. It is not important that either boss of the connecting-rod be abutted against a surface. Lever B and indicator C are mounted on a slide that can be moved transversely, and the indicator spindle contacts with the lever. In an inspection, the slide is pulled forward to bring the lever against the piston wall for the entire length of the piston. Pistons must be straight within 0.0005 inch, plus or minus for the entire length, and if they slant at all, the amount is shown on the indicator. If the piston wall is straight, the indicator will register zero.

Several Inspections Performed in the Cylinder Department

On each cylinder block casting, the squareness of the bell housing flange in relation to the main bearings of the crankshaft, and the distance from the flange face to one face of the central main bearing, are inspected by means of the device illustrated in Fig. 9. The same inspection device is used to check the flywheel clearance and the center distance between the main bearings and the hole provided for the starter housing. The distance from the face of the central main bearing to the face of the bell housing flange is checked by pushing a shoulder on arbor A against the main bearing face, and applying the indicator against the bell housing flange, as illustrated. Then by swiveling the arbor in the bearings to carry the indicator around the flange, the squareness of the flange with the center line of the main bearings can be determined.

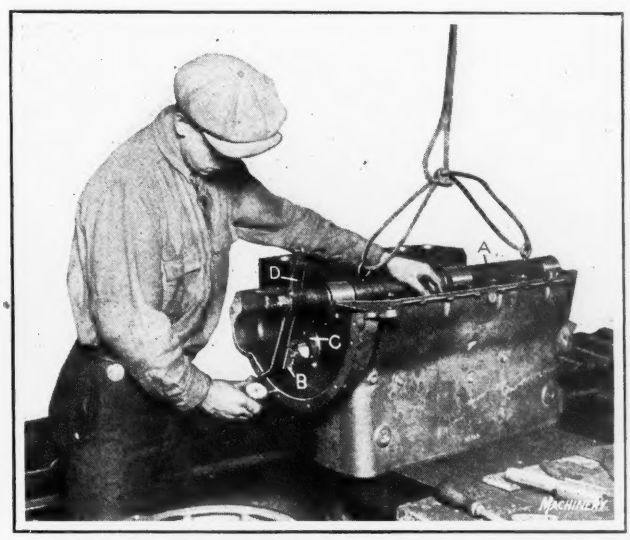


Fig. 9. Gaging Device used in checking Important Dimensions of Cylinder Blocks

If the outer ground edge of lug B on the indicator bracket swings clear as the arbor and indicator are revolved together, sufficient clearance is assured for the flywheel. In inspecting the distance between the center of the main bearings and the starter

housing hole C, a suitable plug is placed in hole C and the indicator is mounted on end D of the bracket, so that the spindle of the indicator will bear against this plug. The indicator reading will show whether or not the center distance is correct within the prescribed limits.

Several cylinder blocks are taken each day to the large surface plate shown in the heading illustration, to inspect the straightness of the bores, the center-to-center distance between all bores, the location of the timer hole relative to the main bearings, the clearance of the valve tappets, etc. In the illustration, the inspector is shown checking the straightness of a bore by means of an indicator after the cylinder block has been accurately set up on one end.

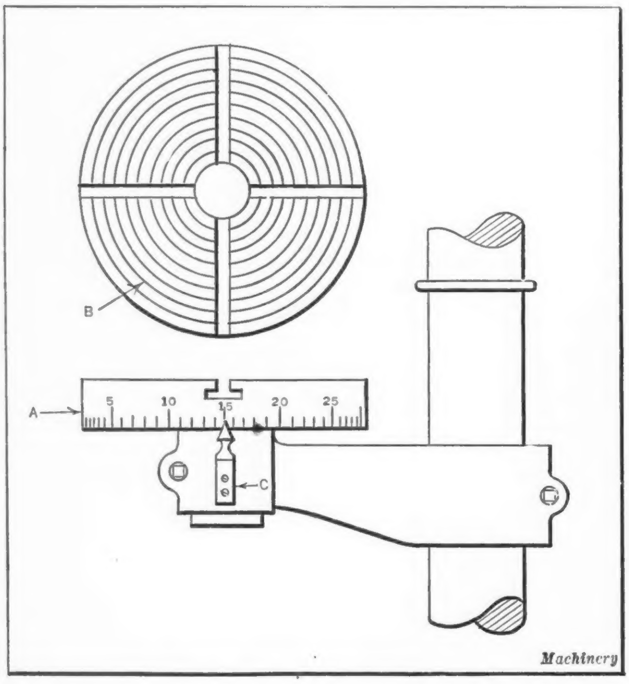
Fig. 8 shows the method of checking the concentricity of each valve seat in relation to the corresponding guide hole in the cylinder head. The indicator is attached to a plug having a diameter to suit the guide hole so that the contact point of the indicator can be conveniently revolved around the valve seat. A set of plugs is provided, the diameters of which vary in increments of 0.0005 inch within the high and low limits of the guide hole diameter, so that a plug can readily be selected to match any guide hole.

* * *

INDEXING ON THE DRILL PRESS

By CHARLES KUGLER

The utility of a drill press can be considerably increased by graduating the table, as shown at A, turning concentric circles B on the face of the table, and attaching a pointer C for use in indexing the table. The table is graduated in degrees, or 360 parts, and the circles at B are 1/2 inch apart. For rough work, such as drilling holes in flanges, the work can be located with sufficient accuracy by simply using the concentric circles as guides. For more accurate work, an indicator can be clamped in the machine spindle and employed for lining up the work with the axis of the table. The index-head of a milling machine is used to graduate the table in degrees. The graduated table permits the work to be properly located under the drill spindle when drilling evenly spaced holes without requiring a preliminary lay-out. Thus time is saved by indexing and drilling the work on the same machine.



Drill Press Table provided with Graduations and Centering Circles

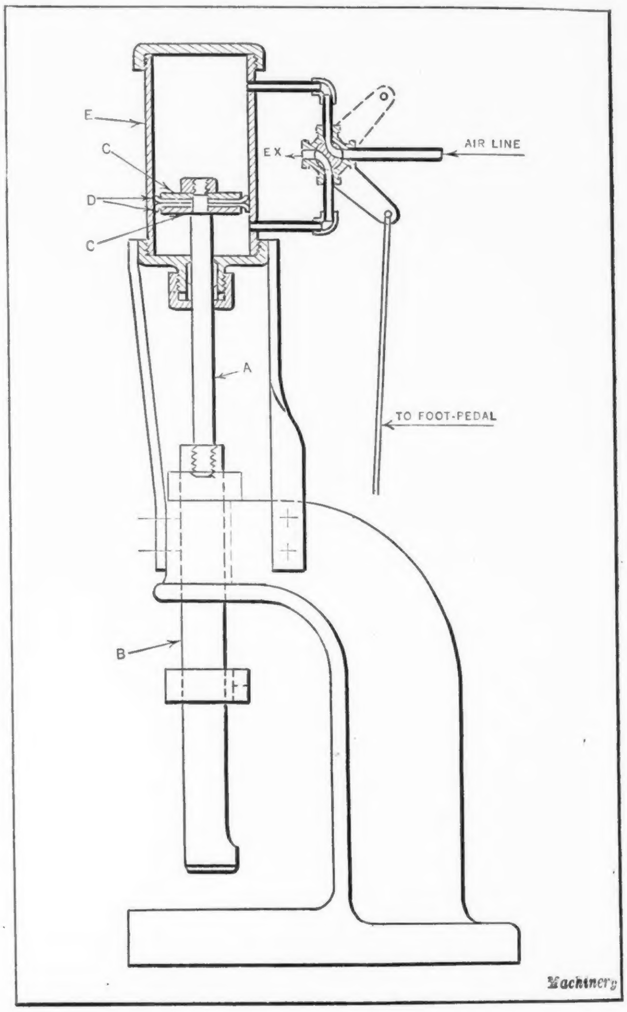
* * *

Gasoline sufficient to operate 2,000,000 automobiles is now being reclaimed as a by-product from natural gas.

OPERATING HAND ARBOR PRESS BY COMPRESSED AIR

By F. EDGAR

The time studies of several jobs that required work to be pressed on arbors for finishing operations showed that one operator could run two machines instead of one, if a rapid means of loading the arbors was available. As the saving would not be great enough to offset the expense of new equipment, the hand-operated arbor press was converted into a quick-acting air press by removing the pinion shaft, handwheel, and hand-lever, and connecting the ram to the piston of an air cylinder, as shown in the illustration.



Arbor Press equipped with Air Pressure Cylinder

The extension A is threaded to fit a tapped hole in the upper end of the ram B. The piston consists of the two metal washers C and the leather washers D. The cylinder E is a piece of steam pipe, with threaded caps at each end, and is strapped to the arbor press. The air lines are connected to a four-way valve, as indicated. Very satisfactory results were obtained with this equipment, the production costs being cut in half. The total cost of the equipment was approximately $40.

* * *

15,000-HORSEPOWER DIESEL ENGINE

During recent years Diesel engines have been built in larger and larger sizes. The largest unit so far built is a 15,000-horsepower Diesel-engine generating-set installed in the power plant of the Hamburg Electricity Works in Germany. It is a double-acting, two-cycle engine built by Blohm & Voss of Hamburg. The engine has nine cylinders, each 33 7/8 inches in diameter, with a stroke of 59 inches. The speed is 94 revolutions per minute. The over-all length of the engine is 77 feet, the greatest width 14 feet, and the total height 39 feet.

Machining Hoist Drums in Turret Lathes

Two Turret Lathe Set-ups Used in a Plant Building Excavating, Concrete-conveying and Other Construction Machinery

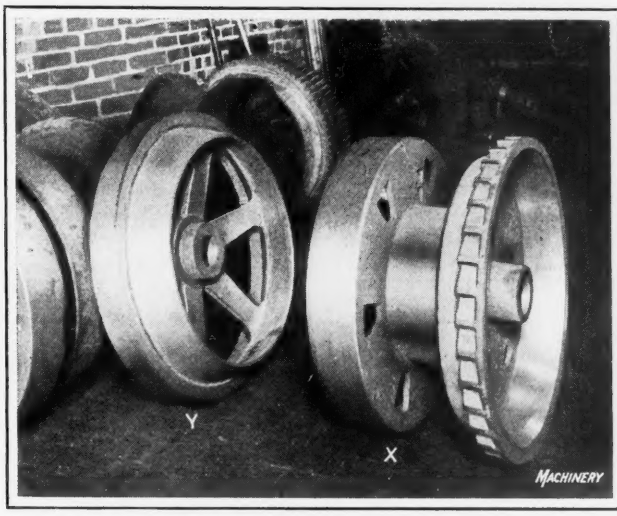


Fig. 1. Hoist Drum and Combined Clutch Cone and Gear which are finished in Turret Lathes

LARGE reductions in the machining time of hoist drum castings for excavating machinery have been effected at the plant of the Insley Mfg. Co., Indianapolis, Ind., through the installation of two turret lathes. The castings finished in these machines are shown in Fig. 1. When the drum *X* was machined in an engine lathe, the minimum floor-to-floor time was seven hours, whereas with the present method, one casting is averaged every fifty-five minutes. The minimum floor-to-floor time of the clutch cone and gear casting *Y* was also formerly seven hours. This part is now finished in sixty-four minutes. Both of the turret lathes were built and equipped by the International Machine Tool Co., Indianapolis, Ind.

The Operation on the Drum Casting

Fig. 3 shows the machine and tooling equipment provided for finishing the drum casting *X* (Fig. 1), while in Fig. 2 is shown a sectional view of this casting. One of the features of the turret lathe operation is that hole *D*, which is 11 3/16 inches long, must be bored to 3.250 inches within plus 0.001 and minus 0.000 inch. In addition, this hole must be straight within 0.00025 inch. These limits are particularly close for a casting weighing approximately 360 pounds and overhanging from the chuck during the operation. A bushing 5 inches long is later assembled into each end of hole *D*, and it is unnecessary to line-ream these bushings after they have been assembled. The accuracy attained in boring hole *D* is apparent from this fact.

The internal surface of rim *A* seats on a standard three-jaw chuck, and the heavy casting is held to the chuck by means of clamps, such as seen at *R*, Fig. 3. These clamps are attached to projections on the chuck which extend through openings in the work. After the work has been mounted on the chuck by means of a high-speed chain hoist and the various adjustments have been made to hold the work in place, the first machining step consists of facing surface *B*, Fig. 2, with a tool mounted on the square toolpost. The next step consists of turning periphery *A* with a tool on the square toolpost and, at the same time, rough-turning the internal taper surface *C*. The tool used for the latter cut is mounted on a slide fastened to one of the faces of the hexagon turret, the slide being moved transversely to suit the angle of taper. This movement is accomplished by roller *T*, Fig. 3, passing along the slot of taper attachment *U*.

In the next step, hole *D*, Fig. 2, is rough-bored by means of a Davis boring-bar mounted on the hexagon turret and piloted in the machine spindle. The boring tools are then changed in the bar, after which hole *D* is finish-bored with the same bar. Next, while surface *A* is being finish-turned with a tool on the square toolpost, the internal taper surface *C* is finished with a form cutter held on a piloted head attached to the hexagon turret. On the same head are also mounted tools that turn surface *J*, face surface *I*, and chamfer edge *E*.

Surface *F* of the hub is next back-faced by extending a bar mounted on a slide tool on the hexagon turret through hole *D* in the work. The slide tool is fed crosswise by advancing the cross-slide, to feed the tool in the front end of the bar across surface *F*. Edge *G* is next chamfered with a tool on the square toolpost, after which surface *H* is faced, also with a tool on the square toolpost, to obtain the specified distance between surface *H* and face *B*. Finally, various sharp corners are smoothed with a file and surface *C* is polished by applying emery cloth.

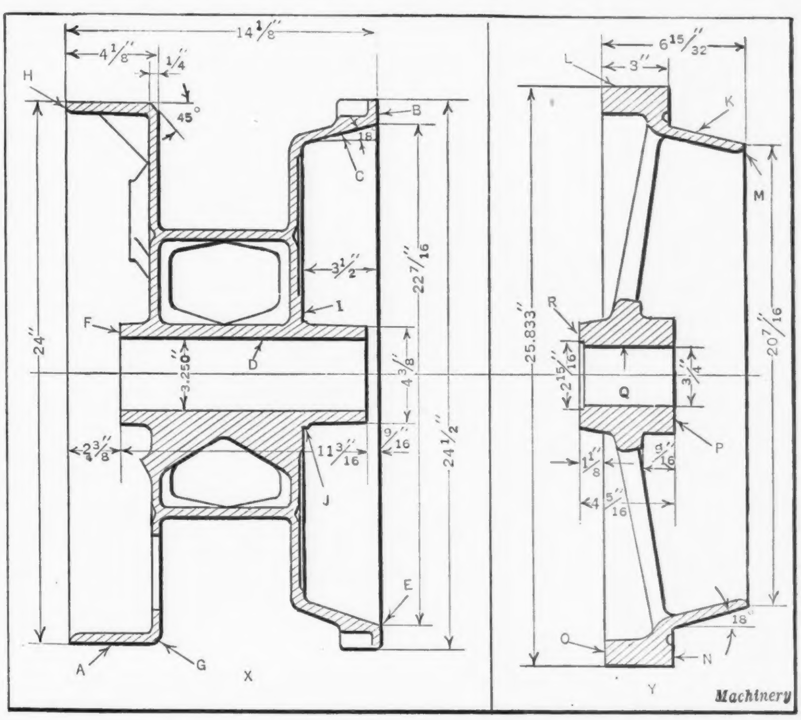


Fig. 2. Sectional Views of the Hoist Drum and Combined Clutch Cone and Gear

Finishing the Clutch Cone and Gear

Fig. 4 shows the machine and tooling equipment employed for finishing the clutch cone and gear *Y*, Figs. 1 and 2. The tooling is very similar to that provided on the machine illustrated in Fig. 3, but the taper attachment used in rough-turning the external taper surface *K*, Fig. 2, is arranged to feed a slide tool attached to the hexagon turret in the opposite direction to that in which the tool is fed

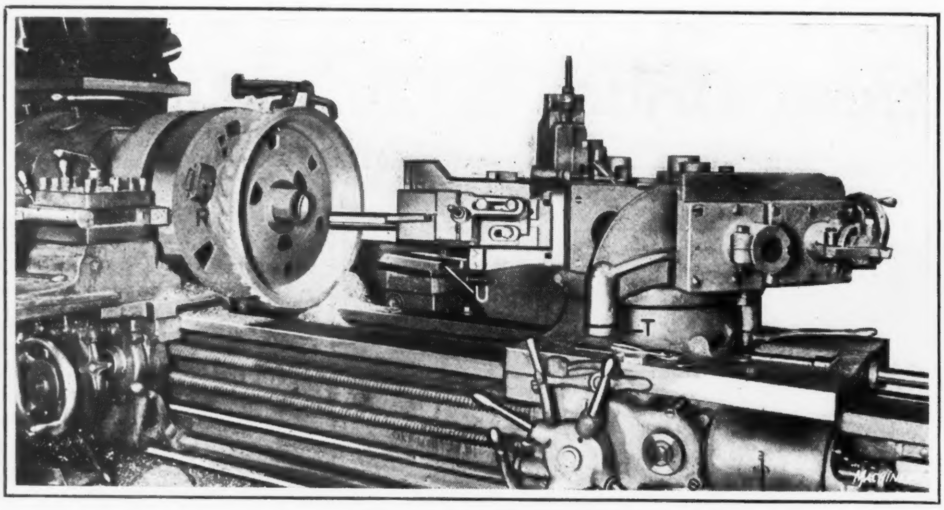


Fig. 3. Tooling Equipment provided on Turret Lathe for finishing the Hoist Drum Casting in One Operation

in rough-turning the taper surface of the hoist drum. The casting is gripped on the inside of rim *L* by means of three jaws of a standard chuck, and flat bars are clamped on the arms of the casting to hold it to the face of the chuck.

The first step consists of facing surface *M* with a tool on the square toolpost, after which side *N* of the gear portion is faced with the same tool. The toolpost is then indexed, and surface *O* rough-faced, after which the toolpost is once more indexed to turn periphery *L*. While this cut is in progress, the taper surface *K* is rough-turned by means of the slide tool on the hexagon turret, which operates in conjunction with a taper attachment at the rear of the machine. Hub *P* is next faced with a tool on the hexagon turret, and then the turret is indexed and hole *Q* rough-bored by means of a piloted bar. When this step has been completed, the tools are changed and hole *Q* is finish-bored with the same bar.

A tool on the square toolpost is next employed for finish-turning periphery *L*, and at the same time that this cut is being taken, surface *K* is finished by means of a form cutter attached to a head mounted on the hexagon turret. Hub *R* is then back-faced by extending a bar attached to a slide mounted on the hexagon turret through hole *Q*. This slide is fed sidewise by means of the cross-slide to feed the tool across surface *R*. In a similar manner, hole *Q* is counter-bored at one end. Surface *O* is next finish-faced with a tool mounted on the square toolpost and, finally, all sharp corners are smoothed with a file.

* * *

RAILROAD APPRENTICE TRAINING

The Santa Fé Railroad has one of the most highly developed apprentice systems of any railroad in the country. The apprentice plan of this railroad was put in operation in 1907; it was started because the railroad found it impossible to secure a sufficient number of skilled mechanics. As described in *Industrial Management*, the objects of the Santa Fé course are to develop fully qualified mechanics and to establish a more permanent working force. There is an apprentice school at practically every shop or roundhouse, instruction being given in nine trades. The number of apprentices is upward of 2000. There are three types: (1) Regular apprentices, for which boys over sixteen years of age are selected; (2) helper apprentices—boys who are chosen from among those who have served one year as helpers; and (3) special apprentices—graduates of technical colleges. The apprenticeship is of four years' duration for the first of these groups, and three years each for the other two groups. The majority of the boys come from the community in which the shops are located or from small adjacent towns.

Training is provided in both shop and class-room work. During the period of his training, an apprentice is expected to learn the work of his craft completely, and a definite amount of time is devoted to each operation. The shop work is under the supervision of eighty shop instructors, each of whom has charge of about twenty-five boys. The class-room instruction averages four hours a week, divided into two periods of two hours each, and is given after working hours. The chief subjects taught are mechanical drawing and shop mathematics.

Most of the instructors have themselves graduated from the apprentice course. Once a year a meeting of all the shop instructors on the railroad system is held at a central point. In addition to the instructors, there is in each shop an apprentice board composed of the general foreman, the department and gang foremen, the shop instructors, and the instructors in class-room work. Each apprentice is brought before this board at intervals of six months throughout his training. Recommendations are then made to the ranking mechanical officer of the shop regarding the work, discipline, promotion, transfer, etc., of the apprentice. A progress record card is kept in duplicate for each apprentice. These records show the amount, kind, and quality of the work done by the apprentice, and prevent keeping a boy too long on one kind of work.

* * *

One of the "eleven forward steps" presented at the twenty-first annual convention of the National Supply and Machinery Distributors' Association was defined as "recognition of the value of simplification." E. P. Welles, president of Charles H. Besly & Co., Chicago, Ill., stated that last year, through simplification, his firm had reduced its inventory by 40 per cent and increased turnover meanwhile. The capital thus released was put into better paying items. Mr. Welles pointed out that if manufacturers and distributors do not anticipate the simplifications that are coming, they will find themselves with many "frozen" assets.

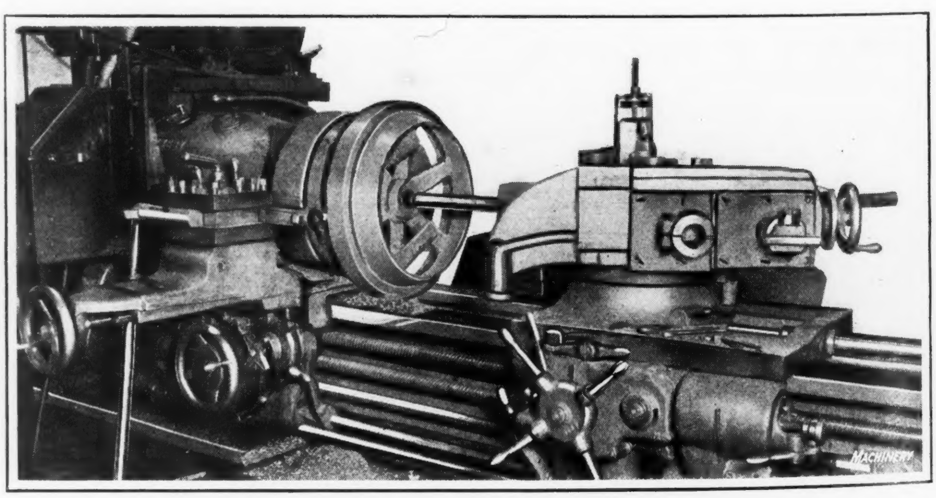


Fig. 4. Turret Lathe equipped for finishing the Combined Clutch Cone and Gear

Model for Designing Screw Machine Cams

By HENRY SIMON

THE theory of plate-cam design for those machines that require a special set of cams for each job is not difficult, and the necessary calculations are so simple as to cause no trouble. This, however, cannot always be said of the problem of clearances, which often causes trouble.

Good practice demands that there shall be no time loss in the sequence of operations, and that, therefore, nothing more than the absolutely necessary safe clearance be allowed. On the other hand, a single mistake which results in a clash of tools may necessitate the complete refiguring of an otherwise carefully planned lay-out, or the scrapping of a set of cams. An even greater item is the amount of time spent in arriving, by means of calculations, tables, and temporary diagrams, at the several clearances along the line from the product at one end to the cut-down on the cam at the other.

Model Detects Interference

The "diagram-model" illustrated in this article is the result of considerable thought given the subject by the writer, who felt that it should be possible to combine all the factors involved into the form of a simple instrument which would give a visual and complete solution of practically all the various clearance problems of any article within the range of the machine. This the model accomplishes.

The several problems of cross-slide and turret-tool clearance, turret-tool head and machine-bed clearance, interference of turret-tool stems, cut-down on cam lobes, adjustment of turret slide, limits of turret- and cross-tool locations, interference of turret tools with the product, and others, are simultaneously solved.

Working Conditions Duplicated by Model

Through the possibility of including the cam-design sheet as part of the instrument, the entire job may be laid out in the presence of the assembly of all the parts entering into the clearance problem in its largest sense, and the connection between cause and effect seen as each move is made. The complete result of any proposed combination of tools can thus be instantly seen and its effect on the shape of the cam and the loss or gain of time measured. While this method of using the instrument has the great advantage of checking the cam design under a practical duplication of working conditions, it is optional to any extent desired, and the cams may be worked out partly or wholly on the drawing board, the instrument still retaining its major value in eliminating the diagrams and calculations otherwise necessary, even if the drawing is never taken from the board.

The speed and assurance with which these various questions can be decided should commend the instrument even if its cost were greater than it is. As a matter of fact, the model is relatively inexpensive. The greater part of the work represents a draftsman's job, and can easily be done by him in a couple of days, while a patternmaker will produce the several wooden parts required in but a few hours' time.

The particular model here illustrated is of a No. 00 B. & S. automatic screw machine. The model consists of a main base *A*, Fig. 1, upon which are rigidly mounted two blocks, the smaller one *B* representing the chuck of the machine, and the larger one *C* serving as a base for the cam design sheet. The turret-slide block *D* is free to slide between blocks *B* and *C*, while flanking *B* and *D* are longitudinally adjustable blocks *E* and E_1, representing the front and rear cross-slides, respectively.

Each of the five parts is engaged by a tongue at the bottom in one of three longitudinal grooves in the base *A*, and the cross-slides have grooves on their inner edges matching tongues on the central blocks *B* and *D*. The chuck block is provided with means for adjustably holding a scale drawing of the product, the cross-slides with movable representations of the toolpost, the turret slide with a turret in which cardboard figures of the various tools can be mounted, the

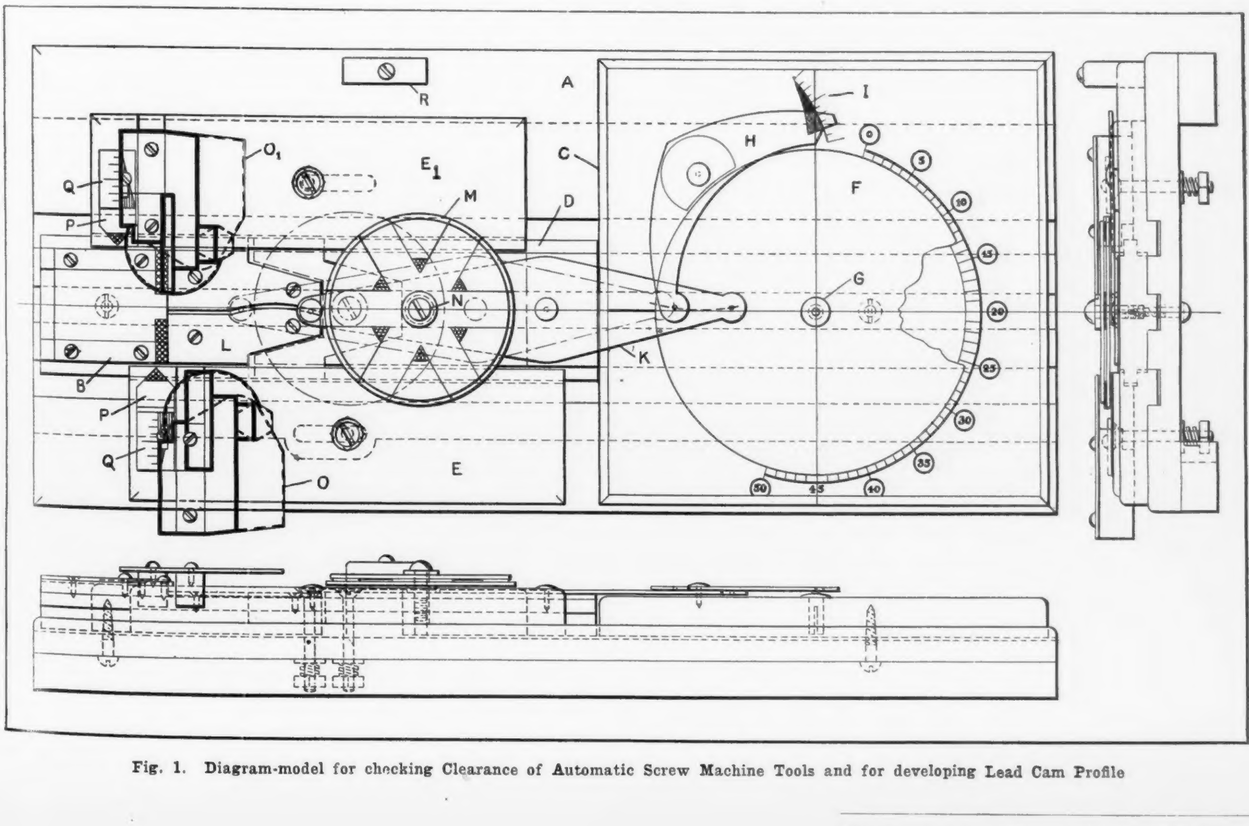


Fig. 1. Diagram-model for checking Clearance of Automatic Screw Machine Tools and for developing Lead Cam Profile

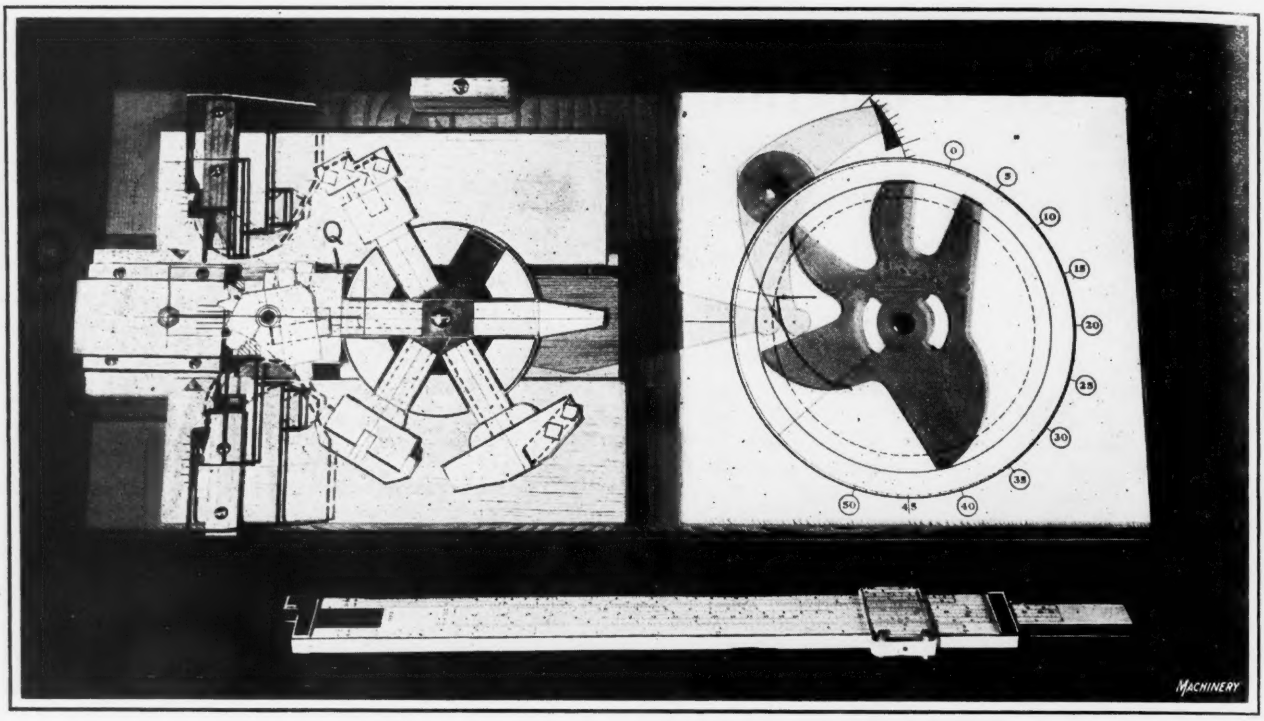


Fig. 2. Diagram-model with Tool Diagrams mounted in Turret

cam-block with a revolvable cam-design sheet, together with means for duplicating the actual travel of cross- and turret-slide cam rollers on the cam; thus all the conditions are fulfilled which are required to show the complete inter-relation and interaction of the various parts, with the exception of attachments such as are used for slotting and similar second operations.

Construction of Model

We will now consider the construction of the five main parts in detail. The top surface of the cam block is faced with bristol board, and carries a circle divided into one-hundredths. The cam sheet *F*, made of stiff paper and in the form of a disk, is held down by a stud *G*, around which it can be revolved. Stud *G* is made with a small boss on its head which has a center mark that permits either the use of a divider or a standard cam templet, after the hole in the latter has been enlarged. To give it a light frictional hold, the stem of the stud *G* is split and the two prongs are sprung apart.

Mounted in the left-hand corner is the cross-slide lever arm *H*, the roller end of which describes a circle tangent to the center line of the model, while the opposite end is formed into an indicator showing on scale *I* the actual height of the

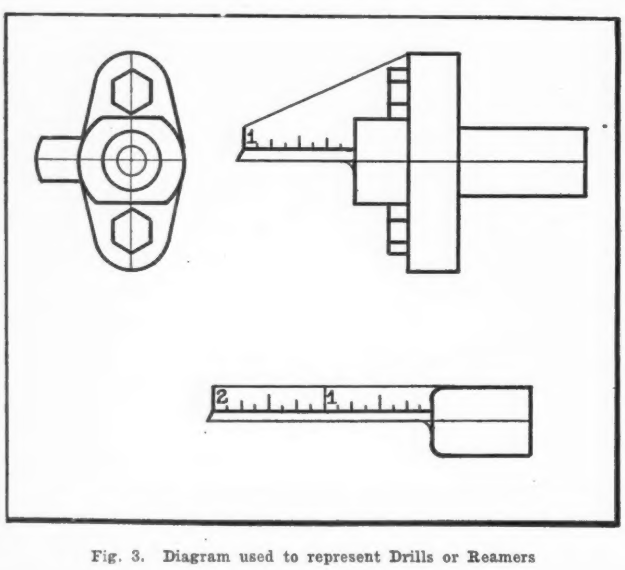


Fig. 3. Diagram used to represent Drills or Reamers

roller on the cam. It will be noted that the scale has a heavy arrow-point extending over 1 inch, this representing the actual travel of the cross-slide roller, while the added quarter-inch is for measuring or marking, without the use of a rule, the additional quarter-inch which the lead lever roller can travel up on its cam.

The function of the lead lever arm is carried out by a lever *K*, pivoted on the rear end of the turret slide; the roller end of lever *K* is made to execute the proper movement by means of a slotted celluloid face-cam *L* in which the front end of lever *K* is engaged. With this arrangement, it is possible to translate the rises and drops on the lead cam directly into movements of the turret slide without the use of compound levers.

The turret *M* is made of a sheet-metal base to which are glued six wedge-shaped sections of bristol board, forming channels to represent the holes in the turret, and faced by a disk of sheet celluloid. Segments of a heavy red circle showing on each of the wedge-shaped pieces designate the shortest length at which a tool shank can be clamped and securely held. The turret assembly is held together by a pivotal screw *N*, and is slightly raised above lever *K* by a spacing washer. The spacing washer passes through a clearance hole in lever *K*, which is large enough to permit the required rocking movement of the lever.

The rear portion of the chuck block *B*, which is above the front end carrying face-cam *L*, has a shallow channel in the top covered by a celluloid plate, to receive the scale drawing of the part to be made. The front edge of the celluloid plate is distant from the turret in its rearmost position by an amount equal to the greatest rated distance of the machine, minus the rack adjustment of the turret slide, the latter adjustment being represented by the back edge of two red bars extending 3/16 inch away from the edge of the celluloid plate.

The dimension 3 inches, which is given as the greatest distance between the turret and the chuck, in the B. & S. tables, is used in the model, but on the machine, this distance is slightly greater. The additional length which is likely to vary in different machines, will often be useful in making a long product, and should be measured on the machine itself. It can be duplicated in the model by adjusting chuck block *B*.

By placing the chuck line on the product drawing coinciding either with the front or rear edge of the red bars, the effect of the two possible adjustments of the turret slide is

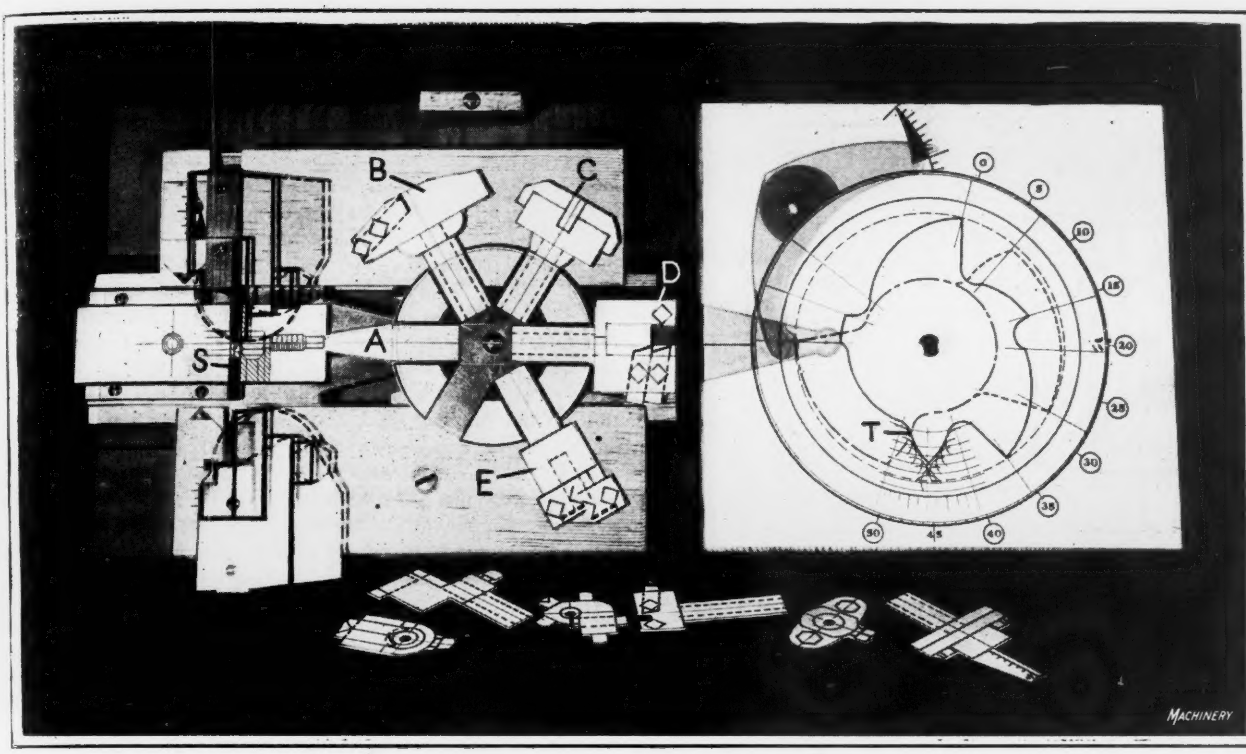


Fig. 4. Diagram-model and Tool and Cam Diagrams

duplicated. In the larger machines having a screw adjustment, the place of the red bars will be taken by a graduated scale.

The cross-slide blocks E and E_1 are made slidable against a light friction secured through the action of springs against a washer on the ends of V-headed screws, or they can be locked by further tightening the screws. Near its left extremity each slide has a dado for the runner block of the celluloid toolpost images O and O_1. Upon the land to the left of these grooves there will also be seen a strip of cardboard P formed into a pointer at its front end; a little further back on the pointer there is a cross-line, and back of this an adjustable 1-inch scale Q, with an arrow-point corresponding to that on the cross-slide lever scale. It will also be noted that on each toolpost image there is a hair line near the left center.

The inch scale represents the range of movement of the cross-slide, while the adjustment of the scale duplicates the effect of the screw adjustment of the slide in spacing it toward or from the spindle center line. The pointer serves to limit the outward adjustment of the toolpost on the cross-slide. It is of use mainly on "form and cut-off" and similar jobs, or whenever there is danger of setting the toolpost out too far. When the pointer is opposite the chuck line on the product drawing, the toolpost is set out as far as it can be and still be safely held.

The toolpost images O and O_1 need some explanation. Each combines a plan view, in solid lines, with a set of dotted lines portraying the element of the side elevation, but with these elements apparently in the wrong relation to each other. In fact, there are really three distinct side views, of the clamp screw, toolpost nose, and form tool, respectively, each so placed as to have its center or axis upon the solid line denoting the corresponding outermost surface of that part of the toolpost which it represents. It is not difficult to understand the reason for this if it is kept in mind that the object of the arrangement is the figuring of clearances and that each successive projecting part may be said to form a distinct and separate clearance problem. By the arrangement shown, it is possible to deal with each of these problems at the exact moment it arises, and without the danger of confusion or omission.

The list of fixtures is concluded with the turret-tool length gage R, which limits the greatest length any tool can project from the turret. Block R is raised 1/4 inch above the plane in which the turret tools revolve, and covers the entire travel of the turret, so that a single revolution of the latter in any position will automatically show whether any tool would interfere with the bottom of the machine bed.

Turret Tool Models

We now come to the turret tool models or diagrams. These are made from heavy bristol board, and the majority of them have a separate end elevation view, besides the side or top view which is placed in the turret. It is essential, in making these tool models, to show all things that are important from the standpoint of clearance or application to the work, and at the same time make the drawing as simple as possible. Where several cutters are grouped together, one behind the other, or the nose of a tool extends beyond the cutter, a notch should be made at one side of the center line up to the front edge of the last cutter.

In die- and tap-holders, both the back position of the head and the extreme pull-out should be shown. The working face or edge of any cutter should be emphasized. Figs. 2 and 4 give an idea of how external cutting tools may be drawn, and Fig. 3 shows a practical way of using a single diagram to

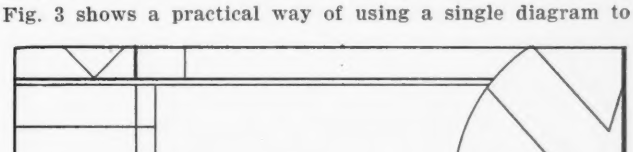


Fig. 5. Tool Diagram showing that Tool will just clear Work

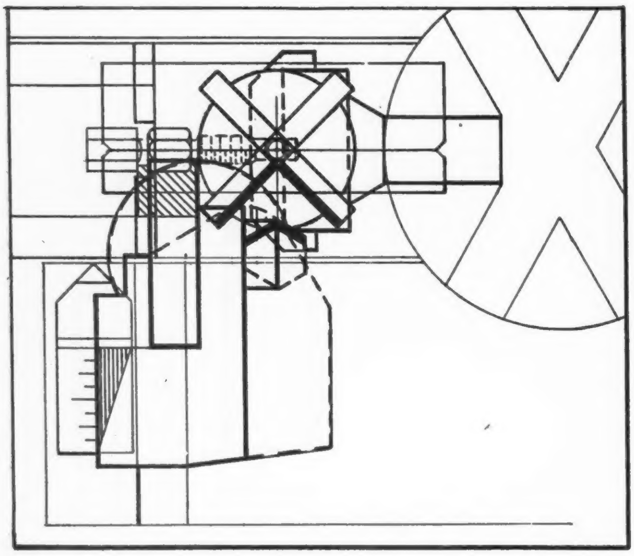


Fig. 6. Method of using Front View to show Clearance

represent drills and reamers extending at various lengths from their holders, by the simple expedient of drawing a scale along one side of the center line. Some tools can be drawn in several different ways, and it is not claimed that the examples given show the ideal representation in each instance.

Many clearance problems, especially those with regard to tools having round bodies or heads without many projecting screws, such as die-holders, drill-holders, or similar tools, can be settled without ever referring to the front views. In other cases, front views are required, as otherwise no clear idea of the true situation could be had. To permit the end views to be conveniently adjusted and tested in various positions, we use the end view holder *Q*, Fig. 2. This consists of a strip of celluloid in which the spindle center line is represented by a silk thread tightly stretched between two notches on opposite ends of the holder. The center line is at a distance of 13/16 inch from one edge of the holder, and thereby limits the positions of the front views to those possible, due to the proximity of the machine bed. When an image is so turned that it is within the back edge of the holder, it will clear the machine bed in indexing.

The only remaining part, and the only one that needs to be remade for each job, is the drawing of the product itself. This is placed on a bristol board strip closely fitting the channel in block *B*, Fig. 1, where it can be adjusted to any desired position. This drawing should always include views

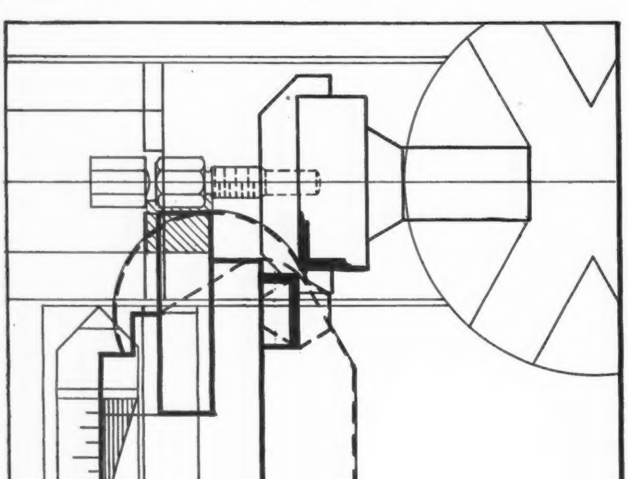


Fig. 7. Diagram used to determine if Hollow Mill and Forming Tool interfere

of whatever cross-slide tools are used, as shown in Fig. 4 with the tools at the limit of their run, thereby forming an accurate guide for the adjustment of the cross-slide images.

Laying out Work on Model

Let us now assume that the hexagon-headed screw shown in Fig. 12 is to be made, and let us follow the procedure in laying out this job on the diagram-model. The screw being fairly long for the No. 00 machine, we use the back adjustment of the turret slide, which means that the chuck line on the drawing will come under the rear edge of the red bars *S*, Fig. 4. Both cross-slides are next adjusted lengthwise until the form tool diagrams on the images are in line with the corresponding views on the drawing.

As a cut-off tool is used on the rear slide, the front graduation on the 1-inch scale is brought just beyond the cross-line on the pointer strip, so that with the hair line over the front graduation on the scale, the front edge of the form tool image will be just past the spindle center line. As the form tool does not travel all the way up, the scale on that slide will be adjusted back from the line an amount equal to the distance between the largest diameter on the tool and the spindle center line, which is about 3/32 inch.

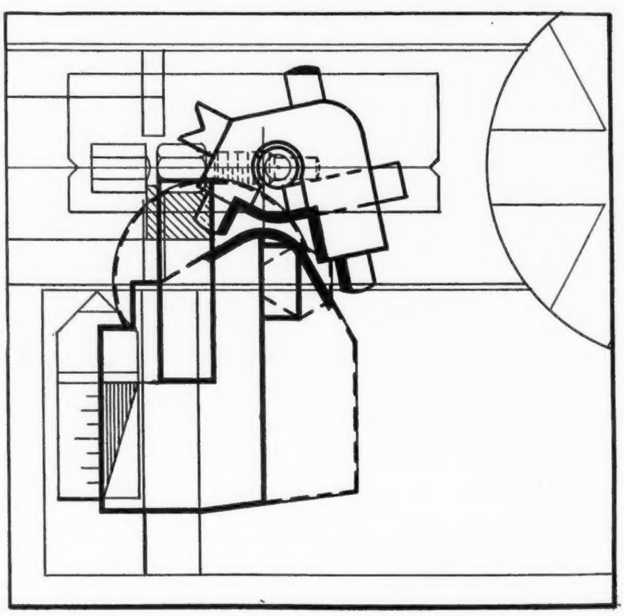


Fig. 8. Diagram used to determine if Forming Tool and Box-tool interfere

The sequence of operations calls for a stop *A*, Fig. 4, balance turning tool *B*, finish hollow mill *C*, box-tool *D*, and die *E*, and these tools are therefore placed in the turret. Several important advantages of the model method of figuring cams immediately become apparent. By revolving the turret once, it can instantly be seen whether any of the tools will interfere with the product in indexing. In the present instance, this test shows that the box-tool and die have only a slight clearance, and can only pass when pushed back as far as they will go. In this case, of course, the arc described by the tool must be considered, and Fig. 5 shows that the die-holder will just pass. Either of the corners of the box-tool shown in the side image will also pass, although in the case of a tool of as irregular a cross-section as this, it is at times necessary to use the end view in determining the exact situation, as will be shown later.

Determining Radial Position of Tools

The remaining tools are all shoved back close to the limit of shank interference in order to reduce the height of their respective lobes as little as possible. It is now clear that the positioning of the tools radially in the turret is correct beyond any doubt. This has been the work of only a few moments, and if any modification is desired, it can be studied in all its effects at a similar small expenditure of time. The same work done the ordinary way would have required five

sets of calculations, each, in turn, involving the factors of total length of tool, distance from front edge of tool to cutting edge, length of body, and length of stem, with the addition of diagrams to show indexing clearance for the box-tool and the die.

Use of Cam Sheet

The blank cam sheet is now put in place, and if during the figuring of the lay-out, there have arisen any clearance problems such as between the turret and side tools, these are checked up. A number of the principal clearances can be approximately determined by the use of a clearance table, but this is not always practical even in the case of the standard tools to which such tables refer, as their figures are based on the interference of the circular form tool only, while there are many cases where the turret advances far enough only to interfere with the toolpost.

One such case is that of the hollow mill used to turn the 0.184 to 0.187 inch diameter. This tool advances far enough only to be in line with the form tool clamp screw, and we therefore proceed to examine the situation as shown in Fig. 6. Advancing the turret until the hollow mill is at the end of its cut, we place the front view holder, with the image in position, in line over the side view of the tool and so as to have it centered opposite the solid line on the toolpost image that represents both the front face of the screw head

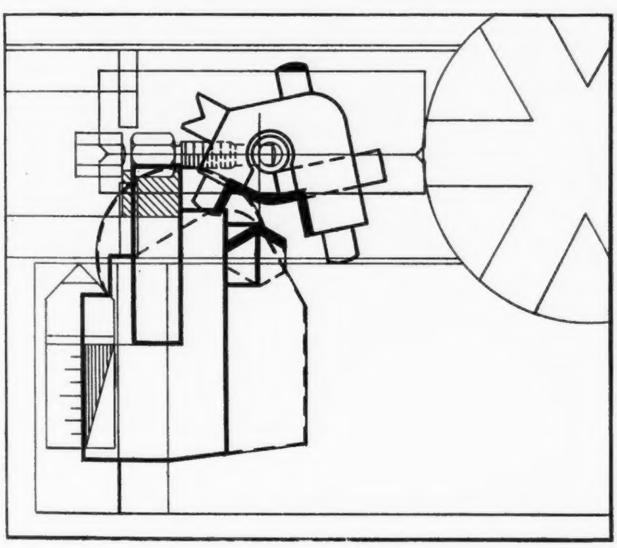


Fig. 9. Turret Tool and Cross-slide Toolpost Diagrams

and its side view center line. It is immediately seen that there is ample room for the screw head to enter into the angle formed by the two blades of the hollow mill, and therefore no allowance is necessary and the tool can cut without interruption as intended.

Another 3/32 inch travel, however, would call for a clearance between the body of the hollow mill and the clamp screw head, necessitating the interruption of the forming cut and the withdrawal of the form tool about 5/32 inch, as shown in Fig. 7. As this illustration also shows, it is not necessary to use the end view in this case, as it is clear that an interference can only arise between the cylindrical body of the mill and the corner of the screw head. In the case of the box-tool, the first step is to find, by means of the end view holder, the several positions to which the tool can be turned.

Detecting Interference

When we examined the hollow mill for interference in Fig. 6, we placed the end view with its center opposite the clamp screw head face line, and this procedure is near enough right in all except the closest situations. In the case of the box-tool, however, the situation is critical, and we must make allowance for the fact that the form tool center is offset 1/8 inch from the spindle center. As the box-tool is left-handed, it is clear that the form tool will have to be turned with its cutting edge down and that the raising block

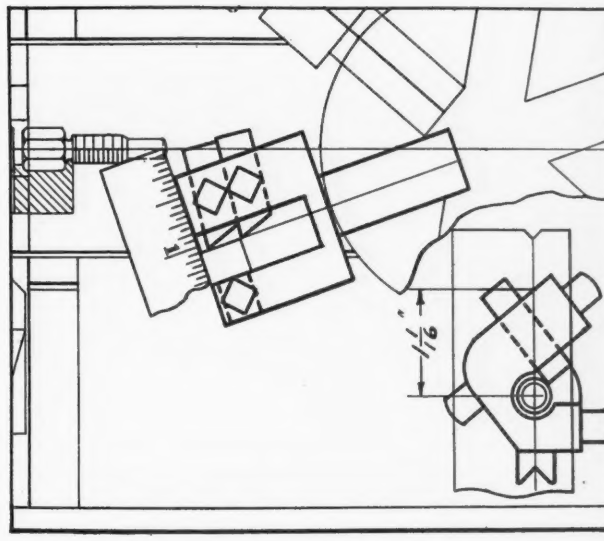


Fig. 10. Determining Indexing Clearance

will be removed, thereby bringing the box-tool 1/8 inch above the form tool center.

This condition is easily duplicated in the model by so placing the end view as to have its innermost, quarter-inch, circle tangent to and to the right of, the continuation of the clamp screw center line, as shown in Fig. 8, and again, in relation to the toolpost nose, in Fig. 9, which shows the parts of the toolpost and turret tool as they would appear on the machine when looking from the spindle toward the turret.

By positioning the end view as in the two illustrations, we will find that it will clear the clamp screw head by an ample amount and the toolpost nose by a sufficient margin. While the cutter-adjusting screw head protrudes very slightly beyond the limit line, this is no great matter, as we can use a shorter screw if necessary. As the "greatest distances" given in the table of machine capacities are invariably slightly exceeded in the machines the screw head would probably clear as it is; but if we do not succeed in clearing the tool until we come up with the form tool itself, then we will have to drop off at the beginning of the box-tool lobe.

As it is, we have no clearance until we reach the form tool itself, and we proceed to establish this, as in Fig. 2. For this purpose, it is best to first sketch the box-tool lobe on the cam sheet. We next run the turret up until the box-tool and form tool faces are in line. The cam sheet is now rotated until the lobe we have just drawn touches the roller.

Now, placing the end view holder with its image coinciding with the form tool center line, we pull the front slide back until the clearance is formed, the hair line giving a reading of 7/16 inch on the scale. Setting cross-lever *H*, Fig. 1, to this figure, and with the drop-off curve on the

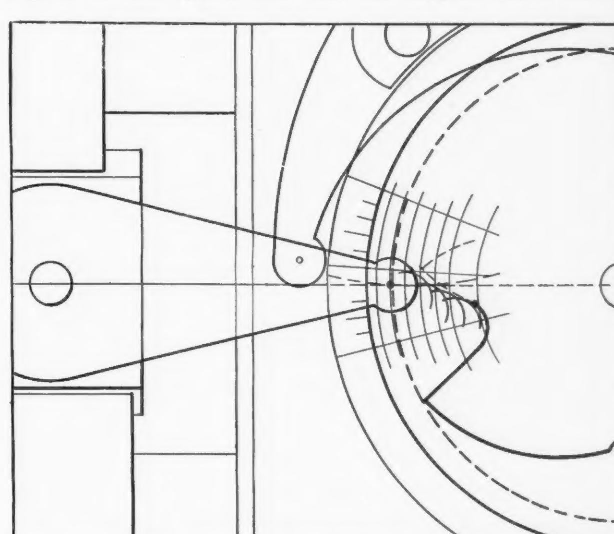


Fig. 11. Method of developing Thread Lobe of Lead Cam

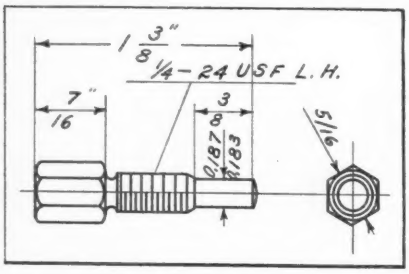


Fig. 12. Details of Product

templet tangent to the roller, we find a position 6 1/2 one-hundredths from the end of the box-tool lobe. Adding another "line" for errors and lag, the form tool lobe must end 7 1/2 one-hundredths before the box-tool lobe.

The final check is that of the clearance of the box-tool in indexing. This is easily tested by measuring the greatest length of the spindle center line projection on the end view as it appears under the holder. As it is practically equal to the greatest face length of the turret image used, it is clear that the tool will pass in that position. Because of this coincidence, the test may seem superfluous, but Fig. 10 demonstrates that this end clearance is by no means a foregone conclusion, and that with the tool placed in the position shown, the highest corner of the box-tool would interfere to the extent of 1/16 inch with the end of the product.

Determining Positions of Cam Lobes

With the clearances established and any necessary corrections made on the lay-out sheet, we now divide the cam sheet into operations, as shown in the accompanying table. This division is easily done by rotating the sheet and marking successive operations each time from zero. We can now find the positions of the lobes on the cam. "Indexing" the turret, we bring the stop up to the product and mark the bottom of the lead lever roller on the zero line (Fig. 4). With this operation repeated for each of the five tools, we have the

TABLE OF CAM DIVISIONS

Operation	Revolutions	One-hundredths of Cam Surface	
Feed stock	20	5	5
Index	20	5	10
Rough-turn — balance turning tool—0.979 at 0.013	76	19	29
Index	20	5	34
	Clearance	2	36
Finish-turn—hollow mill—0.385 at 0.011	36	9	45
Index (Reverse spindle)	20	5	50
Finish-turn—left-hand box-tool 0.604 at 0.010	60	15	65
Index	20	5	70
Die on	20	5	75
Die off (Reverse spindle)	20	5	80
Cut off, 0.160 at 0.002	80	20	100
Form, 0.086 at 0.001 = 86 rev. = 21 1/2 hundredths from 36 to 57 1/2	400	100	...

Time for one product = 10 seconds

start of every lobe with infallible accuracy, and in a few moments' time, as contrasted with the lengthy and much less certain process of finding them by calculation. The lobes themselves are now constructed in the ordinary way, with the exception of the thread lobe *T*, Fig. 4. Here the model gives the added advantage of rendering unnecessary the arcs that ordinarily must be drawn to represent the path of the lead lever roller. Instead, we draw only the usual concentric divisions, as shown in Fig. 11, with the corresponding peripheral marks on the edge of the cam. As the cam sheet is revolved one division, the turret slide is moved up the height of a concentric division, and the arc marked directly against the roller. A clearer drawing as well as better speed are the result.

There are a few things in making the diagram-model which it may be useful to refer to briefly. Sheet celluloid can be easily shaped by scoring it to a fair depth on one side; upon bending it, it will break clean like glass. Cam *L*, Fig. 1, is made of celluloid because of the ease with which exactly matching parts can be produced by merely laying out one shape, scoring, and breaking it.

In the assembly of the three center members, *B*, *C*, and *D*, lever *K* should first be positioned. Next, cam block *C* is put in place. Cam *L*, held temporarily by a C-clamp, is then adjusted until it guides the lead lever roller center in the exact path laid out for it, tangent to the center line on *C*. It can then be screwed down, and minute errors corrected by slightly adjusting the cam block.

As an aid to clearness, various parts of the model should be in two colors. In the model shown, all turret tool images and "greatest distance" lines are in red, the remainder being black. A coat of shellac applied all over the turret tool images will give them a leather-like consistency which will greatly lengthen their life.

Cam blank sheets in large numbers can be cheaply made by turning them on a temporary arbor. The completed cam sheet, with corresponding drawing attached by a clip, can be filed away conveniently, and is instantly ready to be re-checked any time that a change in product or tooling is contemplated. Another use of the diagram-model which suggests itself is the photographing of the entire assembly for the job, to assist the operator in setting up and to serve as office records.

This would certainly avoid considerable questioning and loss of time in many cases, especially in reference to the turret tools to be used and their relative positions. Such a procedure would give duplicate records of the cams themselves without the necessity of making blueprints, besides showing the actual lay-out in the designer's mind and testifying to its correctness.

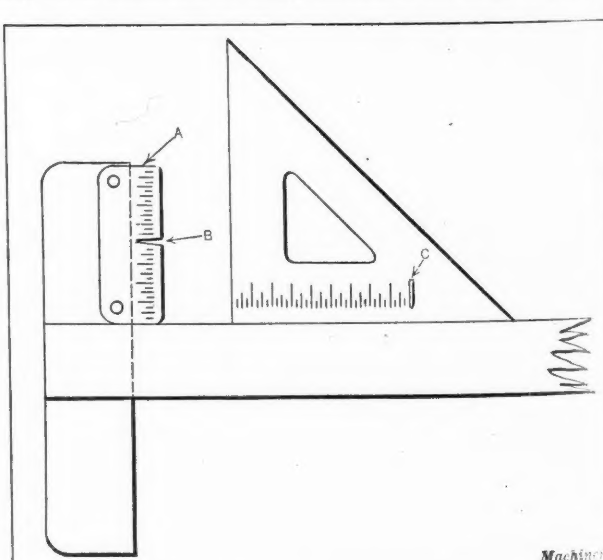
* * *

GRADUATED T-SQUARE AND TRIANGLE FOR SMALL DRAWINGS

By JOHN HOMEWOOD

To facilitate the making of small drawings, the writer has arranged a T-square and triangle as shown in the illustration. The graduated base *A* is of transparent material, about 1/16 inch in thickness, and is provided with a slot *B* which is used as a guide in making the starting point mark for vertical measurements. The horizontal center line is drawn first, after which marks are made for locating the various lines and for laying off the radii of circles.

The 45-degree triangle is similarly arranged for laying off lateral measurements. A slot at *C* and the left-hand edge of the triangle serve as starting points. Although these devices are somewhat limited in their application, they nevertheless facilitate the making of small drawings. The graduations may be in sixteenths or thirty-seconds of an inch, as desired.



T-Square and Triangle provided with Graduations

Notes and Comment on Engineering Topics

In response to an inquiry sent out by the National Committee on Metals Utilization to manufacturers and others interested in foundry practice, asking whether the approximate weight of castings should not be shown on blueprints or inquiries sent to foundries for quotations, more than 95 per cent of the 3000 responses indicated that such a plan would be desirable.

It is estimated that farm fire losses amount to approximately $200,000,000 a year in the United States. Of this loss, about 20 per cent is accounted for by lightning and sparks on roofs. It has been pointed out that by the use of metal roofs, properly grounded, this cause of fire could be entirely eliminated, with a saving of approximately $40,000,000 a year in fire losses on farms. The cost of sheet-steel roofs is comparatively small. A galvanized sheet-steel roof will last from twenty to thirty years under average farm conditions, and if painted at least every five years, will last much longer.

More than one and one-half miles below the surface of the earth an electrically propelled drill, driven by Westinghouse motors, is establishing a new world's record in oil-well drilling in Orange County, Cal. The depth of the hole drilled exceeds 8000 feet—more than 250 feet deeper than the former record established by the People's Natural Gas Co. in a well near the Lincoln Highway in the vicinity of Pittsburg. The California well is the deepest in the world, and is the only well ever drilled to more than 6000 feet with electric power. The well was started on March 13, 1925, and the drilling has been continued without interruption for a year and a half.

It is of interest to note the enormous current-producing capacity of the 60,000-kilowatt turbine generator now being installed in the East River Station of the New York Edison Co. The electrical energy produced by this machine is enough to light 300,000 six-room houses. It could operate thirty Panama Canals, or pull fifty heavy passenger trains. This one machine would have supplied all the electrical needs of New York City twenty years ago. Today it is only the first of nine generating units of equal size to be installed in the East River Station. To raise the steam required for a machine of this size, requires thirty tons of coal per hour, or half a ton a minute, and 96,000 gallons of river water per minute are used for steam condensing purposes.

The first railroad in the Argentine Republic—built in 1857—was a six-mile line. In 1924, the total mileage of the Argentine railroads was 24,000—the largest mileage in any Latin-American country. These railroads are owned by twenty-four different companies, ten of which are controlled by British interests. The mileage of the British roads is more than one-half of the total, and this has been the reason that both railroad equipment and machine tools for shop use have largely been imported from Great Britain. Most of the coal used on the Argentine railroads is also imported from the United Kingdom. Lately, there have been extensive experiments with oil-burning locomotives, and one railroad alone has converted several hundred of its engines for oil burning, and half of its traffic is now maintained by oil-burning engines. Recently, however, there has been an increase in the price of oil and a drop in the price of coal, which has retarded the change from one fuel to the other.

Recent tests of a locomotive feed-water heater invented by Thomas McBride and manufactured by the Worthington Pump & Machinery Corporation, show that it is possible to eliminate from 80 to 90 per cent of the dissolved oxygen in the water fed into a locomotive boiler. At the same time this feed-water heater precipitates a high percentage of the scale-forming chemicals that may be in solution in the water. Exhaust steam is used to heat the water from the tender before it is pumped into the locomotive boiler, the outstanding feature of the heater being that the steam plays on a very thin film of cold water traveling at a low rate of speed, and thereby produces practically instantaneous heating throughout the entire depth of the water film. This, it is stated, has the effect of releasing a large percentage of the dissolved oxygen in the feed-water before it is pumped into the locomotive boiler. As oxygen dissolved in boiler feed-water increases the corrosion in the boiler flues, the new feed-water heater is believed to be a means of effecting a large saving to the railroads of the country.

Copper wire containing a small amount of cadmium has a greater tensile strength and a higher resistance to abrasion than ordinary copper wire, while, on the other hand, its electrical conductivity is reduced very little, or less than 1 per cent for each 0.1 per cent of cadmium added to the copper. The tensile strength, on the other hand, increases slowly with increasing cadmium content, until the latter amounts to 0.6 per cent; beyond this point additions of cadmium cause very rapid increases in tensile strength. Copper wire with but 1 per cent of cadmium is said to have been subjected to a temperature of 260 degrees C. for thirty minutes without showing signs of softening—a marked contrast to the effect produced on pure copper by the same heat-treatment. A cadmium-copper wire having 20 per cent greater tensile strength than wire without cadmium has also 75 per cent greater resistance to breaking after repeated bendings than pure copper wire. In tests made with trolley wires under working conditions, the loss in diameter after eight months' use was less than one-third that recorded for pure copper wire.

To provide electricity for small users of power and light in country districts, where consumers are few and widely separated, has always been a problem of considerable difficulty from an economical point of view. Windmills have long been used for pumping water, and their use for producing electricity in a similar manner appears to be a possible solution of the problem. An interesting report on the subject has been published in Great Britain, obtainable from the Clarendon Press, Oxford, England, at the price of 2/6d.

This report records the results of numerous experiments, in which seven windmill electric generators were tested, varying in capacity from 0.25 to 10 kilowatts. It is stated that while, of course, the economy of these small units cannot be compared with the economy of larger power installations, it is doubtful whether there is any other form of electrical generating plant of the same size that will bear comparison with these small windmill sets, on the score of cost per unit of power produced. The cost of a windmill outfit for generating electricity for lighting and power purposes is stated to be quite reasonable, so much so that its wider use in rural districts is justified. Some form of storage batteries, of course, would be required with these outfits to take care of the demand for electricity when the wind velocity was not great enough to furnish the required drive.

TURNING SMALL ECCENTRIC STUDS

By O. S. MARSHALL

At *A*, Fig. 1, is shown a stud having two eccentric portions at one end of the shank. The collet jaws for holding the work during the eccentric turning operations are also shown in Fig. 1, together with certain parts used in making the collets.

The blanks from which the studs *A* are turned are machined in double lengths to the diameter of the largest portion, which is the thin flange. The turning of the double-length blanks to the larger diameter is done while the bar stock is held in the turret lathe chuck. The collets for the various eccentric turning operations are of the spring type, and are longer than the usual or standard ones. The bored out portions of the collets that grip the pieces while they are being turned must, of course, be parallel with the axis of the collets within accurate limits. To meet this requirement, two sets of centers are employed in turning the collet shown at *B*.

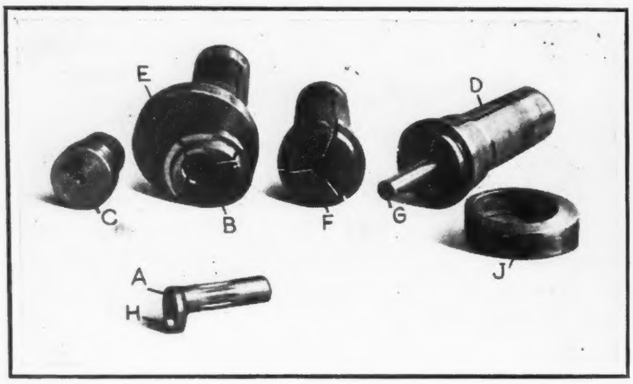


Fig. 1. Special Collets used in machining Eccentric Stud A

The blank from which one of the collets is machined is shown mounted between the lathe centers at *A*, Fig. 2. After turning the blank for its full length, two indicators are used to test the eccentricity and parallelism of the sides. The indicators *B* and *C* are set to test the work at points 90 degrees apart in order to insure greater accuracy. In the case of the collet shown at *D*, Fig. 1, where the eccentricity is 0.562 inch, the indicators are set to read zero at the high side of the blank, after which the blank is revolved one-half a revolution, and a precision block 1 1/8 inches thick is placed between the low side of the blank and the indicator. When the centers are accurately positioned, the indicator will read zero.

After having properly centered the work, it is turned to the desired shape. Next the large holes in the collets are bored from the rear end, leaving a relatively thin wall in order to obtain the desired spring effect. These holes extend up to the collet section proper, that is, to the small tapered end of the collet. This leaves sufficient length for holding the work.

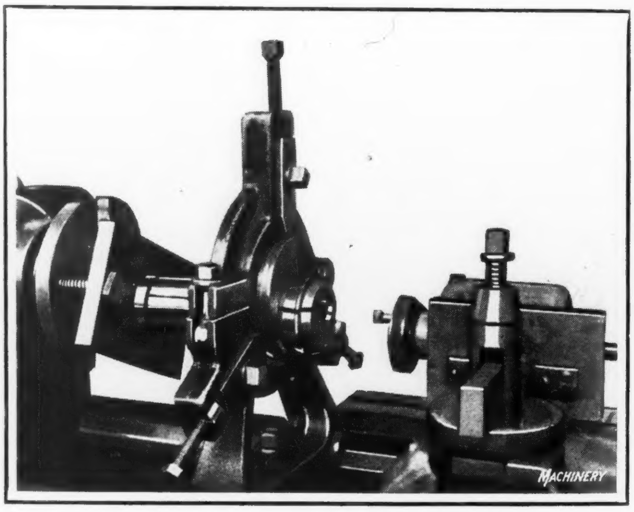


Fig. 3. Set-up for grinding Eccentric Hole in Collet

Two other members are required for each collet, in order to complete the eccentric holes, namely a plug like the one shown at *C* for the rear ends of the collets which have been bored out, and a sleeve *E* such as is shown in place on the collet *B* for supporting the forward or collet part. The plug *C* has three centers and a large hole which permits the air to escape when it is inserted in the end of the collet. These plugs are made a light press fit in the ends of the collets, and set-screws are provided to prevent any possibility of their being displaced. It should be mentioned here that the accurate centering of the blanks is done after the rear ends are bored and the plugs set in place. The collet *B* has two eccentric holes in it, the larger being only 1/4 inch deep. This collet grips the work on two eccentric surfaces.

The set-up for grinding after hardening is shown in Fig. 3. A No. 3 Dumore grinder is shown mounted on the toolpost of the lathe in position for finishing the holes in the collets. The same method of holding the work is employed for the boring operations. The collet shown at *F*, Fig. 1, has gripping jaws which are concentric with the portion that fits in the clamping sleeve. The machining operations on the eccentric studs are performed as described in the following:

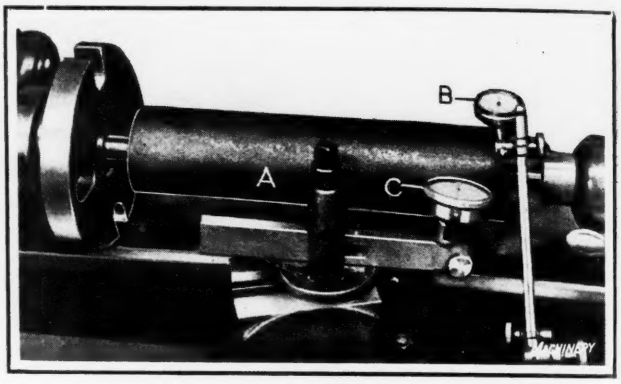


Fig. 2. Method of using Indicators to test Accuracy of Turned Work

A blank pin is gripped at one end in collet *D*, and the other end *G* is turned down as shown. The end *G* is then gripped in the collet *F*. and the opposite end turned down to the same size. This leaves the middle section which contains the original full diameter, of sufficient length for the eccentric flanges and the small turned end *H* on the two pieces of work, which are later separated by a parting tool. The second eccentric part *H* is turned while the work is held in the collet *B*, the flange area being set back in the recess in the collet. In the final operation, the double blanks are parted, and the small ends *H* finish-formed. At *J* is shown the eccentric sleeve used when boring and grinding collet *D*. Pinion teeth are hobbed on the stem of the finished stud before hardening.

* * *

INDUSTRIAL USES OF X-RAYS

The X-ray is generally thought of as having purely scientific or medical applications. At the present time, however, X-rays are used to an ever-increasing extent in industry, the following being a number of the uses to which the X-ray is put in the industrial and manufacturing field: To detect bits of metal in insulating fiber; to establish the centrality of the metal in electric cables; to find whether steel balls are sound; to tell whether the stems of thermometers are made of soda-glass or of lead-glass; to determine the centrality of cores in golf balls; to examine the fit of a shoe; to detect defects in artificial teeth; to estimate the amount of ash in coal; to count the turns of wire in a coil covered with insulation; to get the internal diameter of metal tubing; and to examine the internal construction and assembling of explosive devices.

Letters on Practical Subjects

DEEP-HOLE DRILL

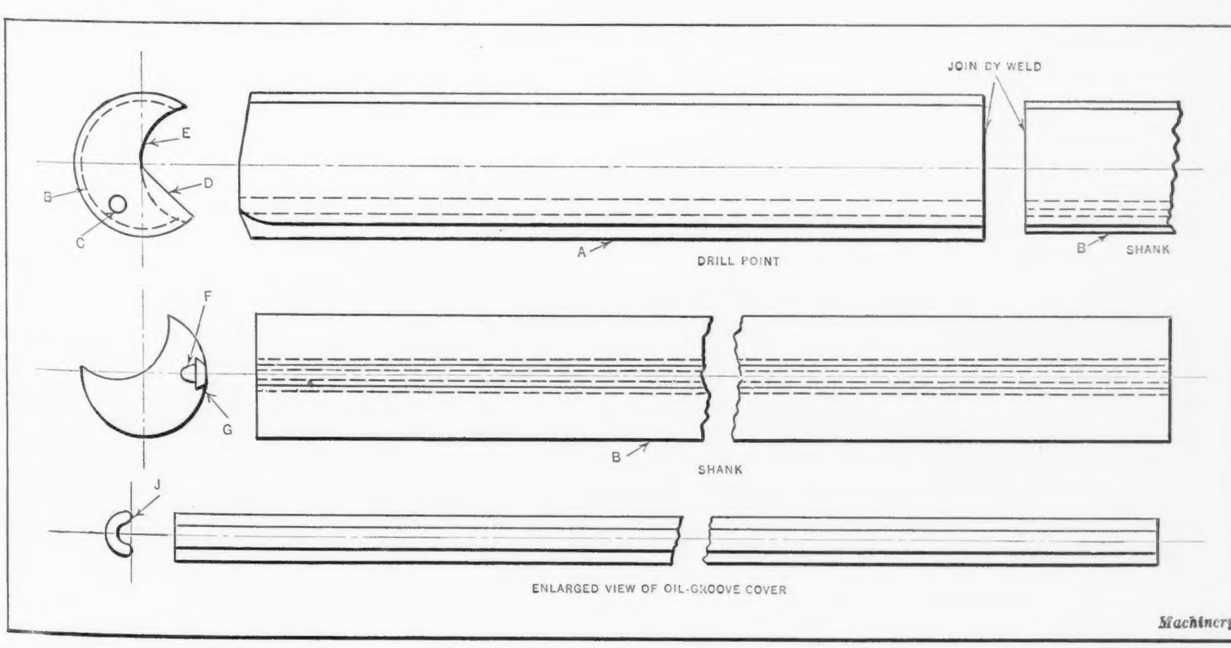
While there is nothing new in the general principle involved in deep-hole drilling, the equipment employed has been greatly improved within the last few years. The drill made up from the parts shown in the accompanying illustration is an example of an improved type of deep-hole drill in which interesting constructional features are embodied. This drill is designed for use in drilling holes 9/32 inch in diameter by 15 1/2 inches deep. The straightness of the drilled holes must not vary more than 1/32 inch in the total length of 15 1/2 inches. The drills are used in a standard upright small-bore rifle-barrel drilling machine.

The drilling machine rotates the work, and the drill remains stationary. In order to operate satisfactorily, a machine of this kind must be designed to maintain accurate alignment of the work and the drill. The machine must also be provided with an automatic kick-out, and have provision for supplying an ample quantity of oil at a pressure of from 1200 to 1500 pounds per square inch. This high oil pressure is required in order to prevent the chips from clogging and to carry them out through the chip groove. Even when every precaution has been taken, a drill will occasionally become clogged, and in order to prevent breakage in such instances, an automatic kick-out should be provided which is designed to stop the motor and thereby prevent the drill from being twisted off. Breakage, however, cannot be entirely eliminated by any safety device.

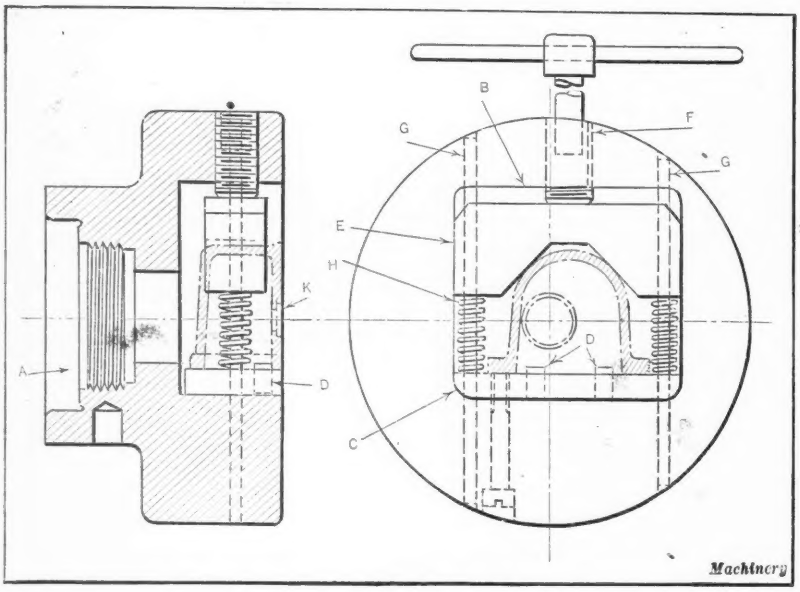
Drills of the design shown in the illustration run at a speed of 1200 revolutions per minute, with a feed of 0.001 inch per revolution, which makes it possible to drill at the rate of 2 inches per minute. The drill point shown at *A* is made of high-speed steel. The oil passage *C* is drilled through the point. The chip groove is shown at *E*, and the cutting lip at *D*. The shank *B* of the drill is made of 1/4-inch drill rod having a dovetail slot *G* milled its entire length above the oil-groove *F*, which connects with the oil-hole *C* in point *A*. The oil-groove is covered by a strip of copper *J*, which is riveted or swaged into the dovetail slot.

The strip *J*, which is shown to an enlarged scale, is made from round copper wire by rolling a groove in one side, thus producing a strip having a crescent shape cross-section. The high-speed steel point *A* is welded to the drill rod shank *B* without closing the drilled oil passage *C* in the high-speed steel point. The welding is done by means of an oxy-acetylene torch after the point is hardened. The copper strip is swaged into place in the dovetail slot after the welding operation by means of a small high-speed riveting machine. No difficulty has ever been experienced from breakage at the weld or from the blowing out of the copper strip, even though pressures up to 1500 pounds are constantly maintained. The final operation in making the deep-hole drill is that of straightening and grinding to size. It may be of interest to note that the cost of this drill was considerably less than the regular commercial type.

Streator, Ill. F. C. MASON



Parts of Deep-hole Drill



Special One-jaw Chuck for Small Casting

GRINDING FIXTURE FOR COMBINATION SQUARE HEADS

A fixture used in grinding the face of the beam or head of a machinist's combination square is shown assembled in view *A* in the illustration below. In order to insure grinding the face square with the blade seat, some clamping means that will not distort the work must be employed. The fixture consists primarily of a cast-iron body *B*, locating block *C*, binding screw *D*, thumb-nut *E*, U-washer *F*, and equalizing clamp *G*.

The square beam or head *H*, to be ground, is mounted on the locating block *C*, the narrow fin *J* which fits the slot in the beam serving to locate the work in the proper position. The binding screw *D* is passed through the hole in the beam, and the washer *F* placed in the groove in the binding screw. When the thumb-nut is tightened, the blade is brought up against the narrow fin of the locating block. The jaws *K* of the equalizing clamp are then tightened on the 45-degree angle side of the square head.

The equalizing clamp is used to prevent the square beam from bending or springing during the grinding operation. The clamp is free to slide, and must be a very good fit in the hole in body *B*. The slot in the fixture body prevents this member from turning in the hole. One jaw of the clamp contains a compression spring, as shown, which serves to separate the jaws automatically when the clamp screw is loosened. It is impossible to spring the square beam with this clamp. A similar grinding fixture is also used in grinding the 45-degree face of the square beam.

Buffalo, N. Y. C. W. PUTNAM

SINGLE-JAW CHUCK FOR TURRET LATHE JOB

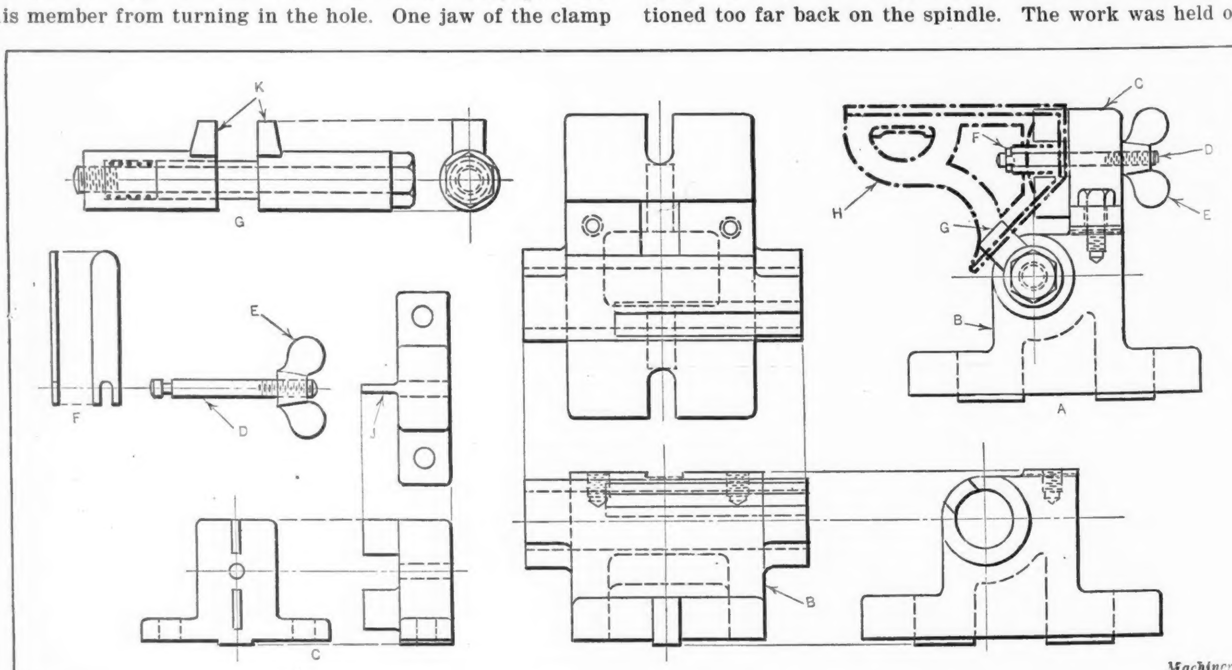
The cast-iron part shown by the dotted cross-section views in the accompanying illustration was required to have the hole and the counterbore at *K* machined on a production basis. The chuck for holding the work is mounted on the spindle of a Warner & Swasey universal turret lathe. The round cast-iron body *A* of the chuck is threaded to fit the nose of the turret lathe spindle. An oblong hole *B* is machined on the front side of the chuck body. The center of this hole is located at one side of the center line of the chuck, in order to bring the eccentric hole in the work in line with the center of the spindle.

A plate *C* is secured to one side of the oblong hole. The machined base of the work rests on plate *C*, and is positioned by the two stop-pins *D*. A V-block *E*, fitted in the oblong hole, serves to clamp the work against the plate *C*. A large set-screw *F*, tightened by means of a standard socket wrench, provides the clamping pressure. The rods *G* are driven into the body *A*, and are a sliding fit in the holes in the V-block. These rods serve to keep the clamping block in proper alignment. The springs *H* cause the V-jaw to slide back out of contact with the work when the clamping screw *F* is released. The machine work on the casting is performed with standard tools mounted on the lathe turret.

New York City B. J. STERN

GRINDING INNER FACE OF RING

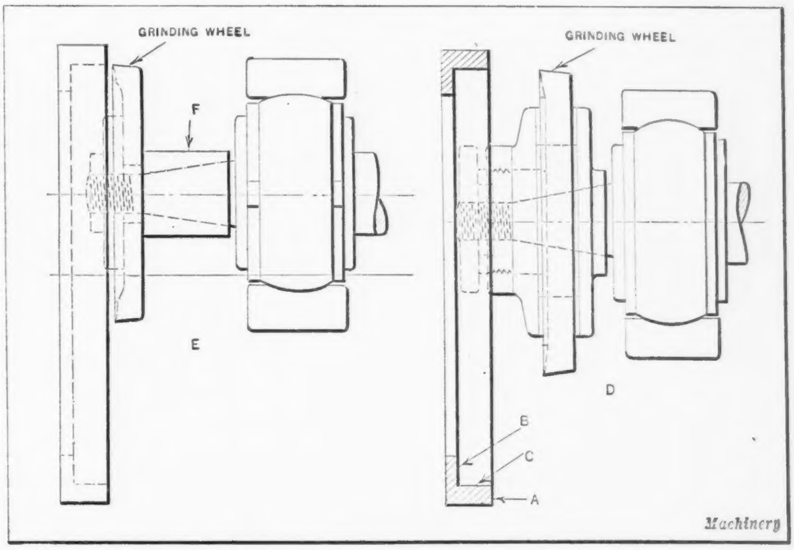
Referring to the illustration on page 291, *A* is a ring 6 inches in diameter which is required to be ground on the surfaces *B* and *C*. It was found practically impossible to finish these surfaces by employing the standard spindle equipment shown at *D*, because the grinding wheel was positioned too far back on the spindle. The work was held on a



Fixture used in grinding Combination Square Head

faceplate by means of clamps, and carefully balanced before beginning the grinding operation. When the wheel was mounted on the grinding machine spindle as shown in the view at *E*, very satisfactory results were obtained. It will be noted that, in this arrangement, a collar *F*, with a taper hole machined to fit the taper spindle, is employed to carry the wheel out to a position near the end of the spindle. This simple means of changing the position of the wheel on the spindle so that only a short portion of the spindle or locking nuts project beyond the face of the wheel should be of interest to every grinding machine operator.

Bridgeport, Conn. SHERMAN W. MILLER



(D) Grinding Wheel mounted on Standard Spindle; (E) Wheel mounted at End of Spindle for grinding Inner Face of Ring

ELIMINATING SCALE WHEN HARDENING

It is generally believed that high-speed steel must be ground after hardening, in order to remove the scale and pitted spots. However, if the steel is given a high polish before hardening, the mirror finish may be restored after hardening by polishing with a piece of emery cloth. This practice can also be used for carbon steels. The higher the polish or finish before hardening, the easier it will be to restore the polished surface after hardening. If a piece of carbon steel is heated and rubbed with a piece of common soap before quenching, it will be found that the steel will not be so hard on the surfaces that have come in contact with the soap. This is a simple and inexpensive method of obtaining selective hardening.

Philadelphia, Pa. CHARLES KUGLER

HOT-PRESSING WASHER ON ROD

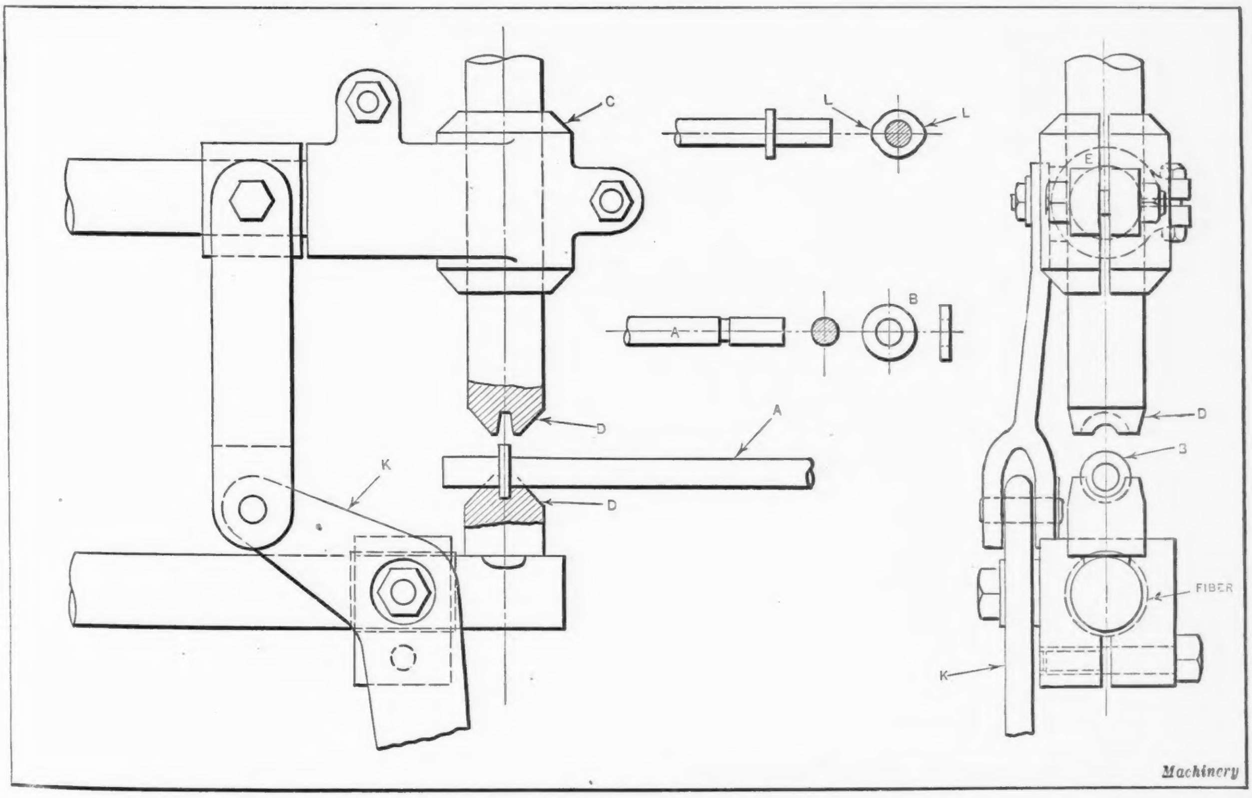
In the accompanying illustration, is shown a spot-welder equipped for hot-pressing washers around rods. A grooved rod is shown at *A*, and the washer that is required to be firmly fixed on the rod is shown at *B*. The ends of the two electrodes are formed to a close fit over the washer *B*, as shown at *D*. The hot-pressing operation is performed as follows: The operator takes one of the rods and places the washer in the grooved electrode. The foot-treadle is then pressed down, causing the electrodes to close on the washer and thus complete the electric circuit.

When the washer has been heated to the required temperature, the lever *K* is pressed down firmly, after which the circuit is opened by lifting the foot from the treadle. Lever *K* then returns to its former position, and the assembled work is removed. After the washer and rod have cooled in the air, they are found to be securely assembled. This operation causes the washer to be upset slightly at each side, where the electrodes do not come together, as shown at *L*.

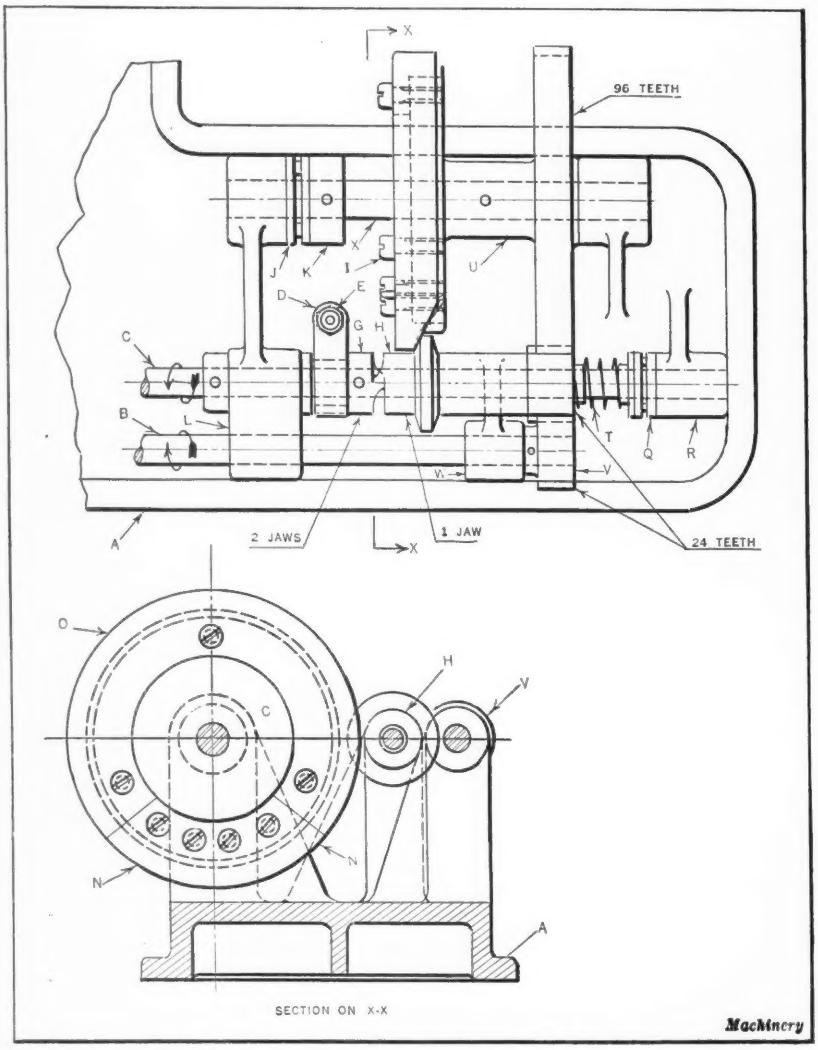
Nijmegen, Holland H. C. TEN HORN

INTERMITTENT MOTION MECHANISM

Some interesting and novel features are embodied in the design of the intermittent motion mechanism shown in the illustration on page 292. Referring to the upper view, the shaft *B* revolves continuously, receiving its motion from one



Spot-welder equipped for hot-pressing Washer on Rod



Intermittent Motion Mechanism

of the constantly rotating shafts of the machine on which it is employed. Another shaft *C*, imparts the intermittent movements obtained by the mechanism. With the cam pieces *N* and *O*, the shaft *C* makes 1/2 revolution, and then dwells while shaft *B* makes 7 1/2 revolutions. Seven additional sets of cam pieces are provided, which can be used in place of those shown at *N* and *O* for obtaining different intermittent movements.

The driving shaft *B* runs in the bearings *L* and *W*. A spur gear *V*, pinned to the shaft *B*, meshes with the gear cut integral with the sleeve *H*. The gear on sleeve *H* also meshes with a gear on the hub *U*. Hub *U* is fastened to shaft *X* by a pin, and has, on the opposite end from the large gear, a turned disk on which the removable cam pieces *N* and *O* are mounted. These pieces are fastened to the disk by screws *I*. The collar *K* is pinned to shaft *X*, and the end thrust resulting from the cam action is taken by the ball thrust bearing *J*.

Sleeve *H*, which slides and also turns on shaft *C*, has a shoulder or collar which is beveled on both sides and which acts against the cam pieces *N* and *O*. Sleeve *H* has a single jaw machined on one end which engages one of the two jaws on member *G*. The member *G*, which is fastened to shaft *C*, is equipped with a leather-lined band brake *D*. The friction drag of the brake is controlled by adjusting nut *E*, which closes or spreads the band as required. The spring *T* acts against sleeve *H*, and forces the beveled shoulder against the cam, the resulting thrust being taken up by the ball thrust bearing *Q*.

As there are eight different intermittent motions to be transmitted, the eight sets of cams must all be of different lengths. When a shorter cam than the one shown at *O* is used, the two cam pieces *N* are slid back, so that they make contact with each end of the shorter cam, and are then fastened securely in place by the screws *I*. Additional tapped holes are provided in member *U* for fastening the new cam pieces in place. It will be noted that the pitch circles of the gears on hubs *H* and *U* and of the cam and the beveled shoulder are the same, so that nearly all sliding action between the cam surfaces is eliminated.

The operation of the mechanism may be explained as follows: Sleeve *H* is driven by shaft *B*, and makes the same number of revolutions per minute. Shaft *X* revolves four times as fast as shaft *B* and sleeve *H*. Using the cam piece *O* shown in the illustration, shaft *C* will dwell or remain stationary while shaft *B* makes 7 1/2 revolutions, after which shaft *C* will make 1/2 revolution, thus completing one cycle. Cam *N* simply slides sleeve *H* back, thus disengaging the clutch until another revolution of hub *U* is made, at which time the clutch is again engaged. The friction brake serves to stop the shaft *C* as soon as the clutch teeth are disengaged, and also takes up any lost motion that may occur.

Bridgeport, Conn. JOSEPH E. FENNO

CAM-CONTROLLED MILLING FIXTURE

The work *A*, Fig. 1, is required to be machined across the U-shaped pad *B*. To do this with an end-milling cutter *C*, and avoid cutting into the hub *G*, which projects above the surface to be milled, several different positions of the cutter are necessary, as indicated at *D*, *E*, and *F*. If only a few pieces are to be made, it is an easy matter for the operator to use the longitudinal feed of the table, controlling the position of the cutter by feeding in or out as required; but for quantity production, this method is unsatisfactory, as it requires the constant attention of the operator. In order to

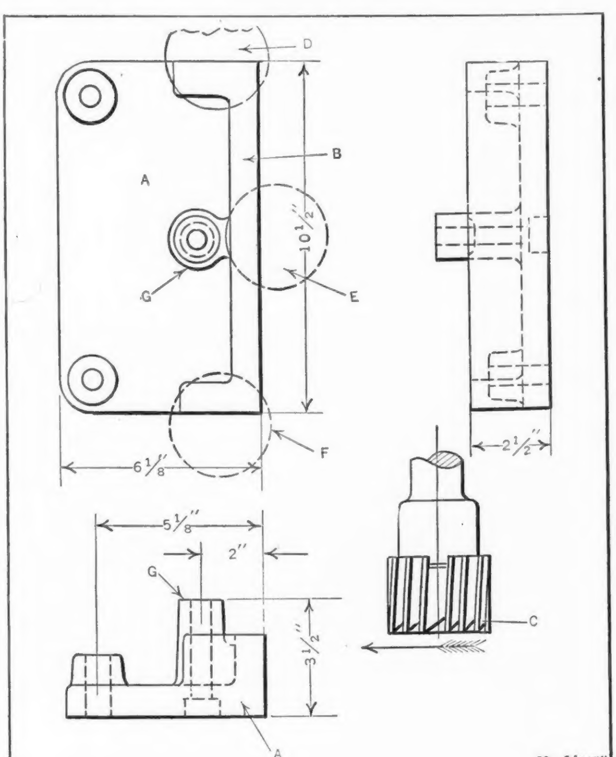


Fig. 1. Part to be end-milled

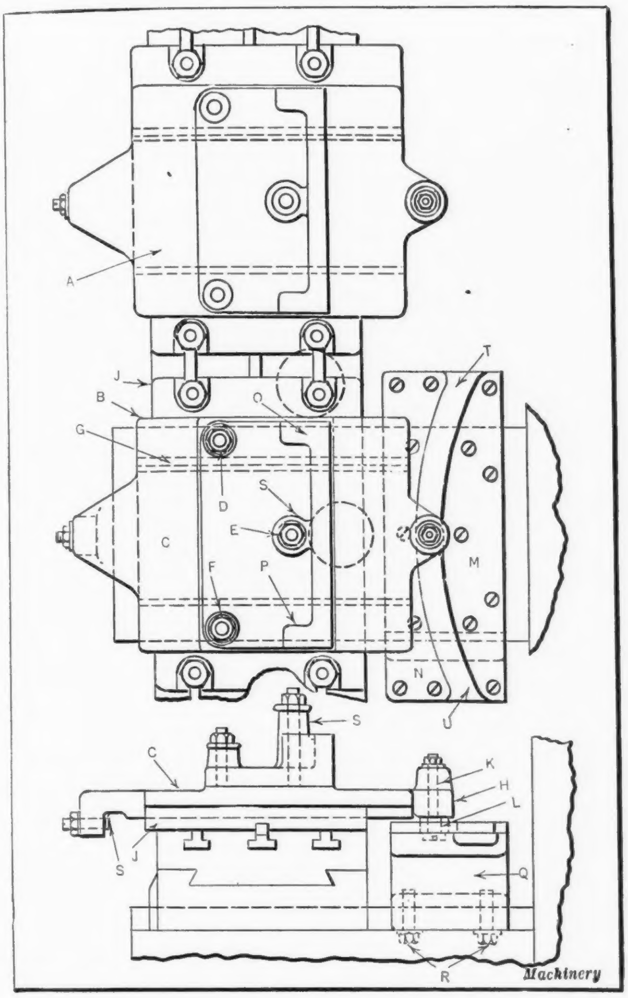


Fig. 2. Fixtures for milling U-shaped Pad on Part shown in Fig. 1

eliminate this waste of time, two cam-controlled fixtures were designed.

The two fixtures, shown at *A* and *B* in Fig. 2, are bolted to the table in the usual way, and as they are alike, the description will be confined to the one shown at *B*. The work is clamped to the sliding member *C* by means of nuts and washers at *D*, *E*, and *F*. The stud at *E* is allowed considerable clearance in the hole in the work, to provide for slight variations in the location of the drilled holes. The slide *C* is mounted on a base *J*, which is bolted to the table and located by means of the central T-slot. The slide is dovetailed and gibbed at *G* for adjustment. One end of the slide projects at *H*, and has a long hub through which bolt *K* passes. At the lower end of this bolt there is a hardened roller *L*, which engages a circular slot formed by the two plates *M* and *N*. The shape of this slot is such that the cutter, traveling in a path of similar form, sweeps the ends of the work at *O* and *P*, and does not strike the boss at *S*. The bracket on which the forming plates are mounted is shown at *Q*. This bracket is fitted to the dovetail at the top of the knee and secured in position by bolts *R*.

After loading one fixture, the operator pushes it forward until the stop-screw *S* strikes the end of the base. This brings the roller *L* into such a position that it will readily enter the cam slot between the plates, either at the end *T* or *U*, as the case may be. The feed is then started, and as the table travels along, the work is moved backward and forward under the cutter, as determined by the shape of the cam. While the cut is being taken on one piece, the operator loads the other fixture so that the cutter is kept constantly at work. With an end-mill such as is used for this operation, a cut can be taken by feeding the table in either direction, and the operator is not in any danger of being injured when loading one fixture while the work in the other is being machined.

Detroit, Mich. ALBERT A. DOWD

DRAWING CIRCLES FREE HAND

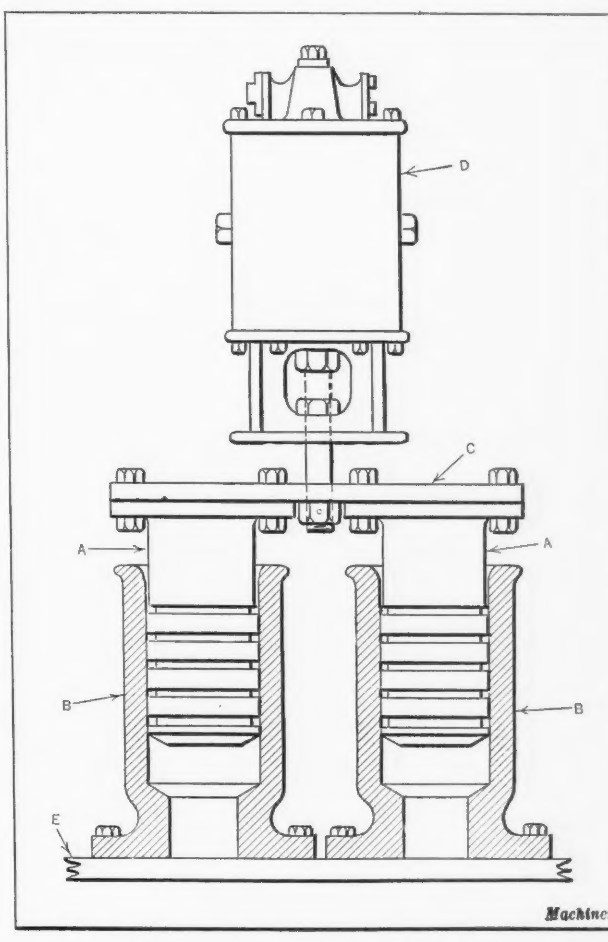
When it is desired to draw a circle and no drawing instruments are available, the writer employs the following method: Press the tip of the forefinger of the right hand down on the paper at the point where the center of the circle is to be located. Next, place the pencil between the thumb and the forefinger which is in contact with the paper. Adjust the pencil so that its point touches the paper at the required radial distance from the center. Now, holding the right hand and forefinger rigid, with the pencil in contact with the paper, swing the paper around in a complete circle, permitting it to pivot about the point under the forefinger. With a little practice, nearly perfect circles can be drawn by this method.

Everett, Mass. DEXTER W. ALLIS

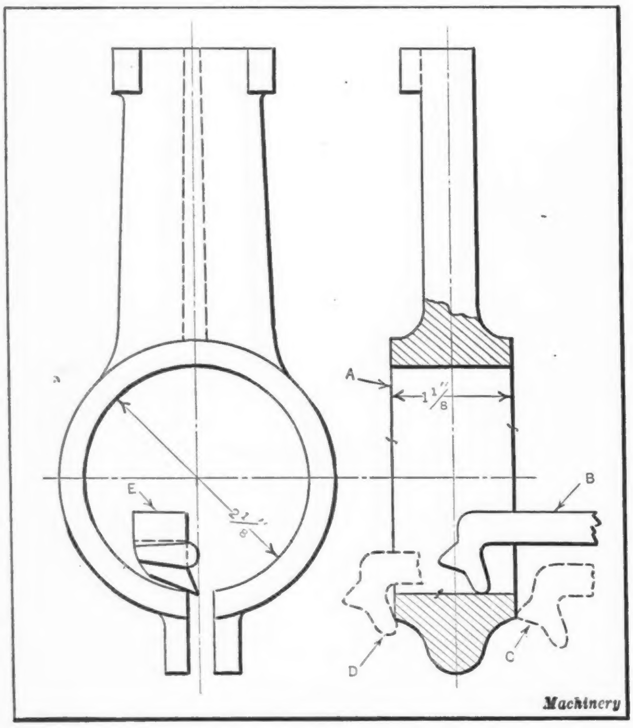
GRINDING-IN STEAM PIPE PACKING RINGS

A simple and effective method of grinding-in packing rings for high-pressure steam pipe expansion joints has been adopted by the Bluefield, W. Va., shop of the Norfolk & Western Railroad Co. The internal cast-iron members *A* are bolted to the 1 1/4- by 4- by 24-inch steel cross-beam *C* after the rings have been fitted. The external members *B*, in which the grinding-in operation takes place, are bolted to a plate *E* fastened to a concrete base. The cross-beam *C* is given the necessary up and down movement required to grind-in the rings assembled on member *A*, by the 9 1/2-inch Westinghouse air pump *D*, the piston-rod of which is connected to the cross-beam *C*. The stroke of the reversing piston of the air pump is shortened to 4 inches for this work. Air at the required pressure is delivered by a 1/2-inch pipe, and a 1 1/4-inch globe valve is placed in the exhaust line to give a cushioning effect at the end of the stroke. The air pump cylinder *D* is clamped to a 12- by 12-inch timber by means of 3/4-inch U-bolts.

Bluefield, W. Va. J. H. DOWELL



Air Pump used to grind-in Packing Rings



Clamp bored and faced with Combination Tool

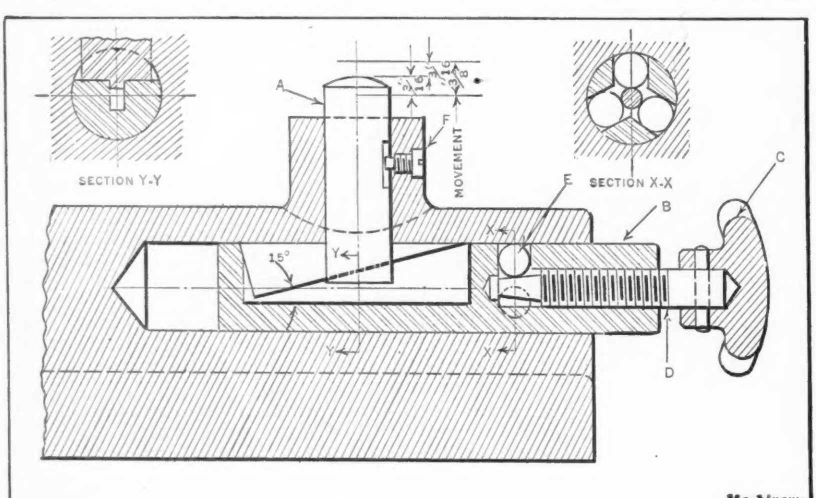
COMBINATION BORING AND FACING TOOL

Having about 100 clamps, like the one shown at *A* in the accompanying illustration, to be faced on both sides and bored out to a diameter of 2 1/8 inches, the writer conceived the idea of machining the bore and the two faces with one tool secured in the toolpost, without changing the work in the chuck. The tool developed for use on this job proved very successful. It is shown at *B* in the position occupied when taking a boring cut. For machining the outer face of the clamp, the cutting point at the end of the tool was brought into action, as indicated by the dotted lines at *C*. The position of the tool for machining the back face of the clamp is shown by the dotted lines at *D*. The end view of the tool at *E* will give some idea of the clearance angles employed for the cutting edges.

Philadelphia, Pa. ROBERT RIMMER, JR.

ADJUSTABLE JACK OR WORK SUPPORT

The adjustable or finger jack shown in the accompanying illustration is used on jigs and fixtures employed for such operations as milling and drilling. The particular jack shown was designed to give the supporting pin *A*, a total vertical movement of 3/8 inch. The pin *A* on this particular jack is 3/4 inch in diameter, and the wedge pin *B*, which serves to raise pin *A*, is 1 inch in diameter and has a wedge angle of 15 degrees. In adjusting the jack to support a piece of work, member *B* is pushed inward until pin *A* is forced up into contact with the work. The knob *C*, secured to screw *D*, is then tightened. The tapered end of screw *D* serves to force the three steel balls *E* outward, causing them to lock member *B* securely in place. The steel balls are 3/8 inch in diameter, and are located in three radial holes in member *B*. A tongue is milled on the end of pin *A* which fits the wedge grooves milled in *B*. This tongue prevents member *B* from turning when tightening clamping screw *D*. The screw *F* serves to retain pin *A* in the boss on the fixture.

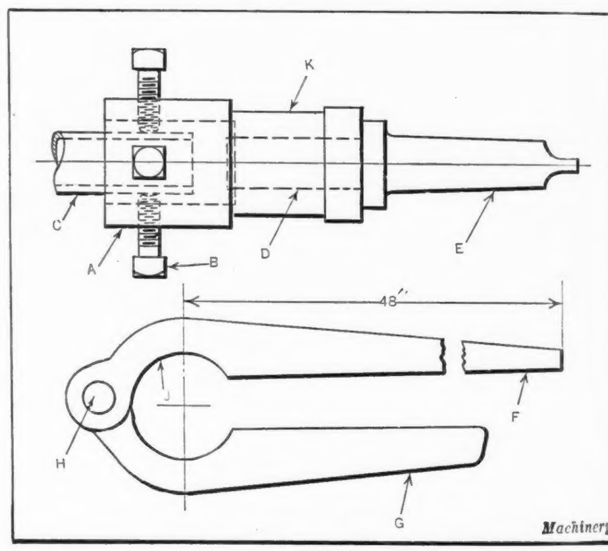


Adjustable Work Support for Use on Jigs or Fixtures

Chicago, Ill. C. F. MURRAY

TAILSTOCK CHUCK FOR TUBE-THREADING OPERATIONS

In the accompanying illustration is shown a chuck that is used in a large shop for holding tubular work while performing turning and threading operations. The chuck member *A* is provided with four set-screws *B*, which grip the work *C* to be threaded. The member *A* is a running fit on the end *D* of the taper shank *E* which fits the tailstock spindle of the lathe. The chuck gripping device consists of the handle *F* and arm *G* connected by the pivot pin *H*. This device is machined, as shown at *J*, to fit the turned section *K* on the chuck member *A*.



Tailstock Chuck and Gripping Device used in threading Tubes

When threading a tube, the threading die is held in the chuck on the headstock spindle. The gripping device is placed over the section *K* of the chuck *A* with the short arm resting on the lathe bed. The handle *F* is then pressed down to prevent the chuck member *A* from turning while the rotating die plate cuts the thread on the work. The member *A* moves forward with the work as the thread is cut.

Washington, D. C. G. A. LUERS

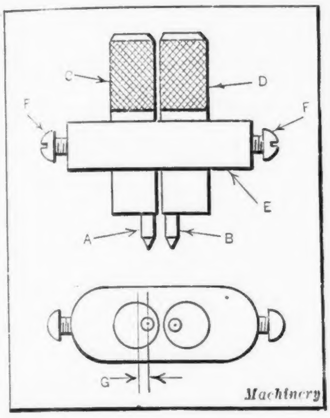
* * *

The largest underground cable in the world is just being placed in service by the New York Edison Co. This cable is capable of carrying current to supply 120,000 horsepower at a voltage of 180,000 volts, which is twice the voltage of any other underground cable in commercial operation in the world.

Shop and Drafting-room Kinks

SPACING CENTER-PUNCH

The center-punch shown in the accompanying illustration was designed to save time in spacing and prick-punching work for a series of evenly spaced holes. The distance between the centers of the two punches *A* and *B* can be adjusted by revolving the punch shanks *C* and *D* in the holder *E*. When adjusted, the punch-holders are secured in place by tightening the screws *F*. The first two prick-punch marks are made by hitting the two holders *C* and *D* at the same time with a hammer. The succeeding center marks are properly spaced by placing one of the centers, for example, *A*, in one of the prick-punch marks that have already been made and then lightly tapping the holder *D* to make a hole with punch *B*.



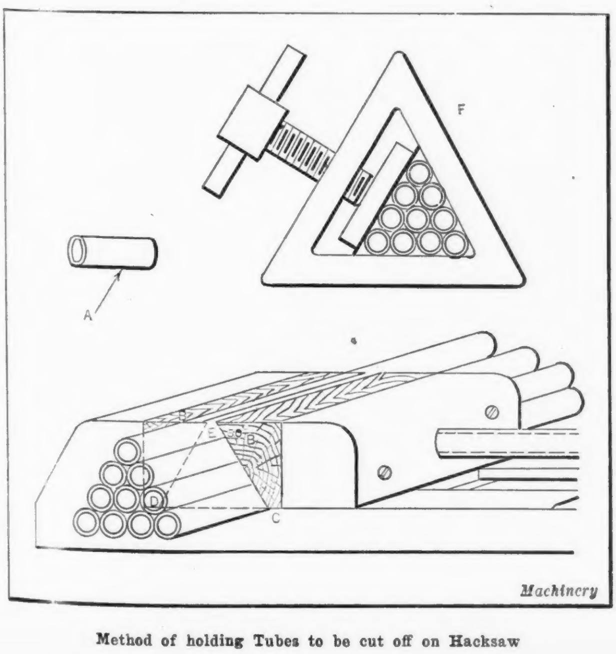
Center-punch for laying out Series of Evenly Spaced Holes

The range of adjustment is determined by the amount of offset *G* of the punches in their respective holders. In the case of the punch shown in the illustration, the holders *C* and *D* are made from 3/8-inch drill rod. They are knurled at one end and at the opposite end 1/8-inch holes are drilled to receive the center-punches, which are made from 1/8-inch drill rod. The punches are retained in their holders by soldering, and can be easily replaced in case of breakage.

Philadelphia, Pa. CHARLES KUGLER

CUTTING OFF TUBES ON POWER HACKSAW

Large quantities of steel tubes were required to be cut up into short lengths, such as shown at *A*. The manner in which the tubes were cut on a power hacksaw may be of interest to some of MACHINERY'S readers. Instead of sawing off one tube at a time, ten tubes were clamped in the vise, as shown in the illustration, so that ten pieces were cut off at each clamping of the work. In order to hold the tubes securely in place, the vise jaws were equipped with wooden blocks *B*. These blocks were beveled at an angle of 60 degrees. A simple carrier *F*, clamped to the opposite ends of the tubes, serves to hold them together and prevent them from slipping.



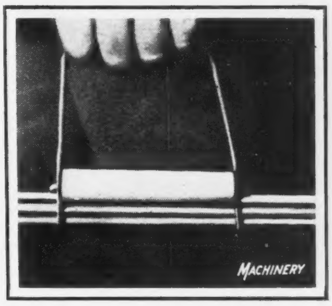
Method of holding Tubes to be cut off on Hacksaw

Nijmegen, Holland H. C. TEN HORN

SIMPLE HAND CARRIER FOR RODS

Light-weight rods, 10 or 12 feet in length, are difficult to carry by hand, but lack of truck space often makes it necessary to employ this method of transportation from one part of the shop to another. It is a simple matter to carry one rod, but when several are carried at the same time, the ends have a tendency to swing around and separate from each other. To overcome this, several simple devices were tried with more or less success, but the one shown in the illustration seemed to be the only entirely satisfactory device.

The holder shown consists of a length of rope and two pieces of iron pipe. The rope is passed through both pieces of pipe and the ends spliced together. One pipe is used as a handle and the other as a distance or spacing piece to keep the rope spread apart so that it will not pull together under the weight. In attaching the carrier, the rods are first laid on the rope with the two lengths of pipe on each side. The handle is then passed through the loop on the other side of the rods and beneath the other length of pipe. When the handle is pulled up, it tightens the rope and the rods are drawn tightly together, so that they can be transported as easily as though they were one solid rod.



Carrier for Bundle of Small Rods

Montreal, Canada H. MOORE

PARTING TOOL FOR WOOD-TURNING LATHE

Of the various tools used in turning wood, the parting tool generally has the poorest cutting action. In order to prevent a scraping action, the tool must be sharpened frequently on an oilstone. It will be found, however, that the tool cuts faster and will not require sharpening so often if the cutting edge is upset slightly with a hammer to form a hook-like cutting edge.

Everett, Mass. DEXTER W. ALLIS

* * *

The steel shovel manufacturers of the country, in conjunction with the Division of Simplified Practice of the Department of Commerce, have eliminated 43 per cent of the sizes of steel shovels to be made in the future. In the past there were four standard grades of high-carbon shovels. In the future there will be only three standard grades, and there will be fewer sizes in each grade. While 43 per cent of the sizes have been eliminated, it is worth noting that these sizes represented only 7 1/2 per cent of the total volume of annual sales; hence, it was uneconomical to continue to produce these sizes. The output of shovels of all kinds is said to be 9,600,000 a year.

Questions and Answers

FOOT-POUND AND POUND-FOOT

J. A. R.—Is there any difference between a foot-pound and a pound-foot? Both of these terms are used in books on mechanics and engineering, but pound-foot seems to be applied only to problems involving torque.

A.—According to prevailing practice and the best usage of the terms mentioned, torque, or turning moment, should be expressed as pound-feet or pound-inches, instead of using the term foot-pounds or inch-pounds. Since the foot-pound is the unit of work and is used in horsepower calculations, it is considered preferable to reverse it and use the term pound-foot to indicate torque or turning moment. The reversal of these terms serves to distinguish readily the two units of measurement—the unit of work and the unit of turning moment. The latter ordinarily is expressed as pound-inches instead of pound-feet, because the dimensions of shafts and other machine parts ordinarily are given in inches.

EMPLOYER'S LIABILITY FOR ACCIDENTS

H. I. L.—How is the negligence of an employer proved in a litigation for damages as a result of injuries sustained by an employe? Give examples.

ANSWERED BY LEO T. PARKER, ATTORNEY AT LAW

A.—The negligence of an employer is proved when the circumstances of an injury are investigated and the facts indicate that the injured person was ordinarily careful, but in some manner the employer, or his representative, was at fault, as a result of which the injury was effected.

However, the negligence of an employer cannot be proved by the mere fact that an accident occurs which caused injury to an employe. The surrounding circumstances are carefully considered by a Court to determine actually how the accident happened. Furthermore, there must be a reasonable amount of evidence to prove the negligence of an employer, or he is not responsible. For instance, if the tool or machinery which causes an injury is operated for the employer, and the accident is such that in the ordinary course of work it would not have happened to another reasonably careful and skilled workman, the employer is not liable, because the carelessness of the employe is presumed to be the proximate cause of the injury.

In a recently decided case where it was disclosed that an employe was injured by a defective hammer, the Court held that it is the duty of an employer to exercise ordinary care to furnish reasonably proper and safe tools to his employes, whether the tools are of a simple or complicated nature. So it is apparent that the simplicity of equipment has no effect of lessening an employer's liability for the payment of damages.

In another case, an employer who had recently installed new equipment was held liable by the Court for damages as a result of injuries sustained by an employe the first day he operated the new equipment. It was proved that the injury was caused by a defect in the appliance. The Court said that the owner or employer should have fully tested a new and untried appliance before permitting it to be operated. Moreover, it was pointed out that the safest and most suitable method of testing a new appliance is to obtain an opinion as to the safety of its operation by some reliable person, such as an expert, who should be capable of giving reliable advice as to the reasonableness of the proposed experiment. If these precautions are not observed, and a new device proves defective, resulting in the death or injury of an employe, generally, the employer is held negligent.

In another recently decided litigation, as a result of a workman being injured while operating a moving saw, the Court said that the most important point for consideration, in determining whether the employer was negligent, was whether or not the saw was located and arranged so as to effect unreasonable and unnecessary danger to the employes in the discharge of their duty; whether the saw was situated with due consideration and utilization of suitable guards; and whether it was possible to actually attach safety appliances without seriously affecting the practical operations of the saw.

It may be said with dependable certainty that where it is the duty of an employer to install a guard on a machine or other dangerous appliances, and a workman is injured in the performance of his duties as a result of the unguarded mechanism, the employer is negligent and liable for the payment of damages. Furthermore, an employer is not relieved of liability because it may be shown that a guard would only have reduced the hazards of the workman. In other words, it is necessary for an employer to supply reasonably efficient safety devices, even if the guard or safety attachment may cover only a portion of the machine.

CLEARANCE BETWEEN BLANKING PUNCHES AND DIES

H. M.—I would like to obtain some information on the clearance required between blanking punches and dies.

A.—One of MACHINERY's correspondents answers this question by stating that the clearance between a blanking punch and die is determined largely by the thickness and the kind of material to be blanked. For thin material, such as tin plate, he recommends that the punch should be a close sliding fit in the die, as otherwise, the edges of the blank will be ragged. For soft steel up to 1/8 inch in thickness, he recommends a clearance between punch and die of 0.010 inch. This clearance should be increased to 0.015 inch for material from 1/8 to 3/16 inch in thickness. Again, if the diameter of the punch is less than twice the thickness of the material to be blanked, it may be necessary to make the die as much as 0.030 inch larger in diameter than the punch to reduce the tendency of the punch to break off.

When aluminum is blanked, an angular clearance of at least 1 degree should be given to both the punch and the die. Punches and dies for blanking aluminum should be carefully cleaned at regular intervals to remove the fine particles of aluminum that adhere to the edges of the tools. Keeping the surfaces of the tools bright and polished will facilitate the blanking operation.

MACHINERY'S HANDBOOK, sixth edition, page 1121, recommends the following formula for obtaining the clearance between punch and die: Divide the thickness of the stock by a number or constant selected for different materials, as follows: For soft steel and brass, 20; for medium rolled steel, 16; for hard rolled steel, 14. As an example, what would be the clearance between a punch and die to be used for perforating or blanking soft steel 0.050 inch thick?

$$\frac{\text{Thickness of stock}}{20} = \frac{0.050}{20} = 0.0025 \text{ inch}$$

It will be noted that the clearances obtained by this formula are slightly smaller than those recommended by the correspondent quoted above. Evidently no hard and fast rules can be given, but satisfactory results may be expected by either rule; in any case, in addition to following rules in cases of this kind, it is often necessary to use one's own judgment and experience and sometimes to do some experimenting. Rules of this kind, however, are useful as general guides, and provide a satisfactory starting point that often saves unnecessary experimenting.

INVESTIGATIONS IN THE TURNING OF METAL

A paper entitled "Rough-turning with Particular Reference to the Steel Cut" will be read at the annual meeting of the American Society of Mechanical Engineers, to be held in the Engineering Societies' Building, 29 W. 39th St., New York City, December 6 to 9. The authors are H. J. French and T. G. Digges, both of the metallurgical staff of the Bureau of Standards, Washington, D. C. Briefly, this paper describes tests made to determine the effect upon the performance of tools in turning when the chemical composition and the chemical properties of the steel cut are varied. The tests include lathe turning tests on carbon, nickel, low- and high-chromium, chromium-vanadium, chromium-molybdenum, and nickel-chromium steels having tensile strengths between 65,000 and 195,000 pounds per square inch. A partial study was also made of the effects of cutting speed, feed, depth of cut, and coolant on tool life and power required in cutting.

The primary purpose of the tests was to extend to current commercial alloy steels some of the empirical laws originally worked out by Taylor in rough-turning carbon steels. Since in all cases investigated, the results agree with the empirical equations originally derived by Taylor, the numerical values of the different constants required for their application to modern high-speed and high-tensile alloy structural steels become a particular interest. These are summarized in the various charts given throughout the paper referred to.

From the standpoint of the steel cut and the performance of the several types of modern high-speed tool steels, the following facts are considered of special interest:

If machineability in rough-turning is measured by tool life or the cutting speed permitting the tools to last a definite time, then measurable differences are observed between the various structural alloy steels cut in the lathe tests. However, steels which, when heat-treated to show low tensile strengths around 80,000 to 100,000 pounds per square inch, permit the tools to cut for the longest periods, do not show similar superiority when treated to show high values of tensile strength in the neighborhood of 175,000 to 195,000 pounds per square inch. In other words, the character and slope of the cutting speed-tensile strength curves vary for steels of different compositions.

At low tensile strengths (for the steel cut), increase in carbon or the addition of special elements such as nickel and chromium reduces the cutting speed. However, 3 1/2 per cent nickel steel containing 0.3 per cent carbon is more machineable than steels containing similar carbon and 1 per cent chromium, with or without the addition of the elements molybdenum, vanadium, or nickel. At very high tensile strengths, in the neighborhood of 180,000 pounds per square inch, the order of superiority is reversed and the nickel-chromium and chromium-molybdenum steels permitted the highest cutting speeds.

With the exception of the chromium-vanadium steel, for which the cutting speed dropped very rapidly with increase in tensile strength, these differences in machineability were generally no greater than differences in tool performance, arising from variations in the quality and heat-treatment of the high-speed steels from which the tools were made.

The tests described show that when one high-speed steel, either through superior quality, modification in chemical composition, heat-treatment, or for other reasons, has a higher cutting speed than another in cutting relatively soft steel, it will show approximately the same superiority in feet per minute when cutting harder steels. Under such conditions, the percentage of increase in output, whether based on the rate at which metal may be removed or the amount of metal cut before the tools must be dressed, is greater the lower the cutting speed. Since the cutting speed which may be used decreases with increase in the hardness of the steel cut and with increase in feed and depth of cut, it follows that the greatest gain from superior tools is made in cutting the hardest steels or in taking the heaviest cuts.

The addition of about 4 per cent cobalt to the customary high-tungsten, low-vanadium type of high-speed steel, combined with a modification in heat-treatment, was again found to improve tool performance. However, it was shown that any gain from these sources may be more than counteracted by inferiority in the quality of the steel.

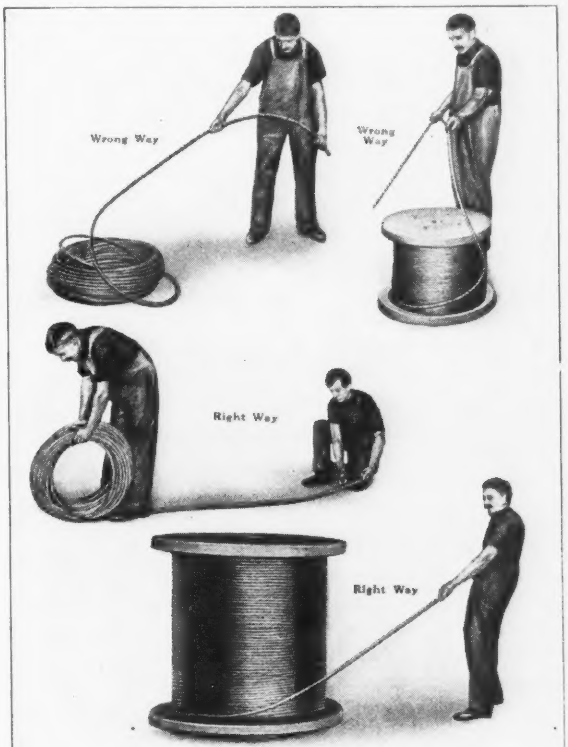
The improvement in performance produced by cooling the tools with a heavy stream of water, or other liquids, was found to be relatively small, amounting in the described experiments to from 5 to 15 per cent increase in cutting speed. The effect of such liquids is largely to reduce the working temperatures, for water gave a greater gain in cutting speed than an oil-water emulsion, which, in turn, was more effective than oil.

Hardness tests of the steel cut, with the Brinell, Rockwell, Shore, Herbert, and Bierbaum hardness testers, as well as factors ordinarily determined in tension tests, did not give quantitative criteria of the cutting speeds of the different steel forgings. The best general guide to the cutting speed was given by the Brinell hardness and the tensile strength of the steel cut, but quantitative relations were only given by actual tool tests.

* * *

HOW TO UNCOIL WIRE ROPE

Wire rope is ordinarily shipped and received either in coils or on reels. In uncoiling or unreeling wire rope, it is essential that no kinks be allowed to form. Once a kink is



How and how not to handle Wire Rope

made, no amount of twisting or strain can take it out, and the rope is unsafe for work. Never uncoil a wire rope as you would a rubber hose or manila hemp rope. Lift the coil to its edge and unroll the coil, allowing the rope to lie flat until used. Right and wrong methods are shown in the accompanying illustration, prepared by the American Cable Co. When wire rope is received on a reel, it must never be taken off or unreeled in the manner designated "wrong way" in the illustration, for such a method will invariably develop kinks and spoil the rope.

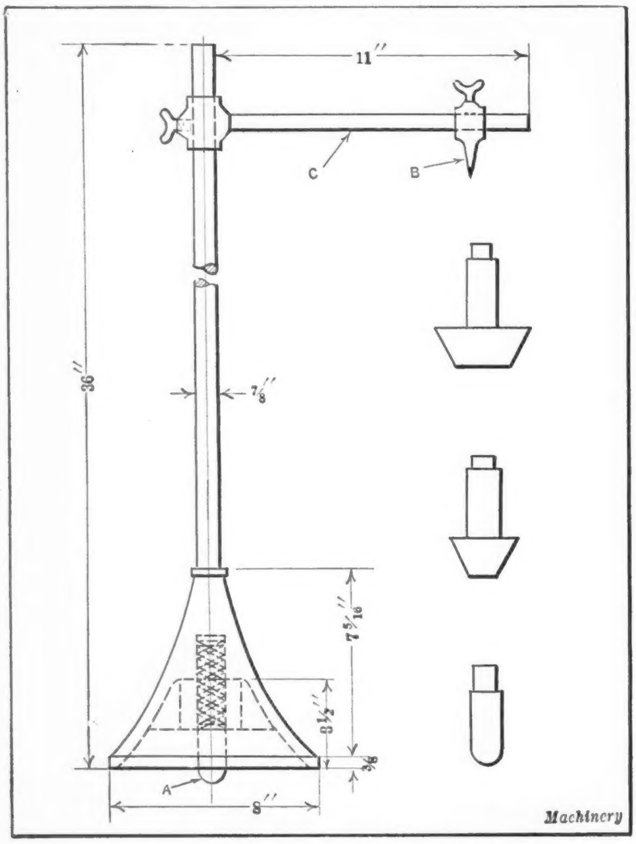
* * *

According to Thomas T. Read, the total mechanical horsepower produced and employed in the United States exceeds 190,000,000, of which 111,000,000 is produced by coal, 67,000,000 by petroleum, and about 12,000,000 by water power.

GAGE FOR SETTING ECCENTRIC CRANKS

By J. R. PHELPS, San Bernardino Shops, Atchison, Topeka & Santa Fe Railway

The eccentric cranks that operate certain modern types of locomotive valve gears must be set relative to the center of the main driving wheel axle, so as to give the right amount of throw. The gage shown in the accompanying illustration is used for this purpose. The base is hollow, and it has a spring-supported plunger *A* which engages the center in the driving wheel axle, thus locating the gage in line with the axis. While the gage is held in this position, the center of



Gage used in setting Eccentric Crank to a Given Distance from Axis of Main Driving Axle

the eccentric crankpin is located the required distance from the driving wheel axis by means of pointer *B*. The position of this pointer is indicated by graduations on rod *C* which enable it to be set without the use of a scale. Two different sizes of conical plungers are shown at the right-hand side of the illustration, in addition to one having a spherical end. The conical forms are intended for exceptionally large centers, such as are found in axles that have a 2-inch hole through them to facilitate heat-treatment.

* * *

WHY USE THE "NOT GO" GAGE?

In a talk by Charles H. Norton of the Norton Co., reference was made to the difficulties encountered in getting grinding wheels with holes made to reasonable tolerances in the early days of the development of the grinding machine. He recalled an incident which, he said, may make us all smile now, but which at the time was more troublesome than funny. In order to insure definite limits on holes in wheels for grinding machines, Mr. Norton had two limit plug gages made with which to inspect the holes; one was a "Go" gage that was to pass through the hole, and the other was a "Not Go" gage. Unfortunately, these gages did not seem to produce any improvement in the hole sizes, and an investigation was made. It was found that the inspector had put the larger plug gage away, because he found that he couldn't get it into the hole when he tried it, and surely there was no use in having a gage around that was too large for the hole.

* * *

IS THERE A BEST WAY TO HARDEN STEEL?

By CHARLES KUGLER

On reading different opinions on how hardening should be done, in September MACHINERY, on page 57, the writer is led to ask: What is the correct way to harden? In thirty years' experience as a tool and die maker, he has found as many ways to harden steel as there are men doing this kind of work. Some shops insist that a cold piece of steel be placed in a cold furnace and the furnace temperature brought up to the hardening point. Others insist upon placing the steel in the furnace at a temperature of about 800 degrees F., and then bring it up to the hardening point.

For the last six years the writer has seen all these rules violated in one of the largest plants in the country. In this plant, the management insists that the furnace first be brought up to the hardening point, after which the steel is placed in the heating chamber. This rule holds good for all kinds of steel except high-speed steel, which is preheated. In the cases observed, nearly all kinds of steel, both oil- and water-hardened were used, and yet satisfactory results seemed to be obtained. In fact, the furnace is kept at a temperature of about 1500 degrees F. during the working day. A large variety of dies, punches, cutters, reamers, and other tools are hardened in the manner described, and the workmen are not allowed to use any other method.

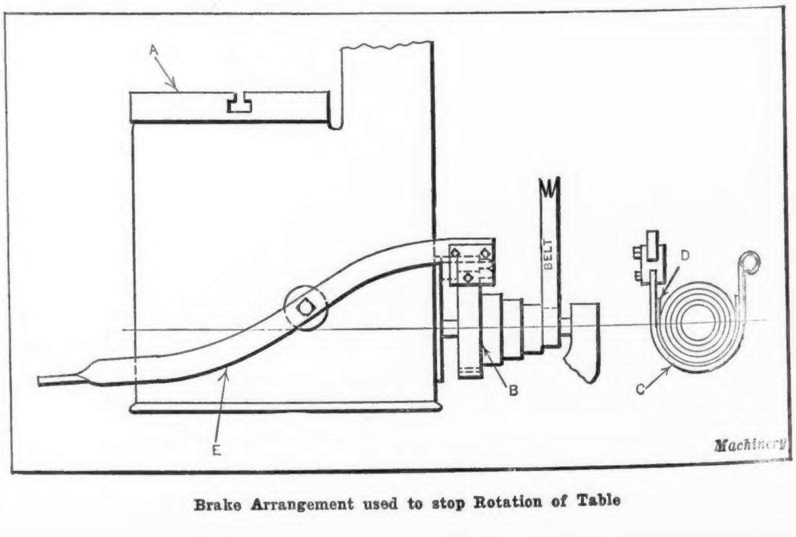
* * *

FOOT-BRAKE FOR VERTICAL LATHE DRIVE-SHAFT

By B. J. STERN

The writer was once employed in a shop where a great deal of the work consisted of machining brass castings. One of the jobs was the machining of a brass valve body on a vertical lathe. As the cutting speed was rather high, the table *A* continued to revolve for quite a while after the clutch was thrown out, much to the annoyance of the operator, who was on piece-work.

To overcome this trouble, the low-speed steps of the driving cone pulley *B*, which was never used, were fitted with a brake-band *C* having a leather lining *D*. This brake-band, by means of the bent lever *E*, produced a powerful braking effect on the cone pulley. This braking action served to stop the machine almost instantly. As the brake is operated by the foot, the operator's hands are left free to load and unload the work.



Brake Arrangement used to stop Rotation of Table

Brass Forgings*

By O. J. BERGER, Harvey Metal Corporation, Chicago, Ill.

THE art of brass forging is comparatively new. In the last six years, the number of concerns forging brass and copper in this country has increased from six to nineteen. The prime reasons for forgings replacing brass castings are as follows: Forgings average 50,000 pounds per square inch tensile strength, as against castings 20,000 to 30,000 pounds per square inch. They are made of virgin metal. It is impossible to make a porous forging; hence, you never find a leaky forging. When using castings, you never know whether they will leak or not. Sometimes steam will disclose a leak that water or air will not show; sometimes air or water will disclose a leak that steam fails to show. Sometimes the expansion or contraction of a casting will cause a leak to show up or will close up a leak. Forgings are never scrapped or tested for leaks.

Comparison of Machining Costs

Forgings contain no sand to dull and wear out tools, and consequently, the life of tools used on forgings is many times longer than that of tools used on sand castings. The increased life of tools means less tool cost; less grinding of tools means increased production of parts.

Forgings are clean, and alike as to strength, shape or size. When chucked, they run true, and for this reason, less allowance for finish is required on a forging, as well as less labor for machining. A forged surface is often accurate enough to save a machine operation. When a part is made from a casting, more stock is left for finishing and often the part will not true up. This adds to the loss when using castings.

Finish and Strength of Forgings

A buffed forging, nickel-plated, looks far better than a polished, buffed, and plated casting. In bronze-, copper-, or gold-plating, forgings never "spot out"; castings generally do.

Forgings can be made lighter than castings and still have greater tensile strength. With forgings, uniform parts are assured at a fixed price for every lot. With castings, the grade of material varies; you are never sure of the cost until you see how many castings will be scrapped after machining.

Saving in Material Costs

Considerable saving can be shown on screw machine parts, where 30 per cent or more of the stock is turned into chips. If a part has a flange on it, or a hub on each side, it will always prove a saving to forge it. Take the case of piano caster rollers made of bar stock; the bar stock costs $150 for a thousand parts; if forged, the material costs approximately $70 per thousand parts.

Composition of Material

The composition of forging rod varies little from a 60-40 mixture. The S.A.E. No. 88 specification of forging rod gives copper 58 1/2 to 61 1/2 per cent; lead 1 1/2 to 2 1/2 per cent; and the remainder, zinc. This material forges and machines very freely. Forging rod, or the material used for forgings, is extruded from cast billets, 5 inches in diameter by 6 feet long. These billets are cut to length to suit the size of the extrusion press and the size of the bars being extruded.

Extrusion dies contain a number of holes corresponding to the size of rod being run. Pressure is exerted on the end of the heated billet against the extrusion die. When the material starts coming through the die, men with tongs support each bar and carry it along a table with rollers on it. This keeps the material fairly straight, and prevents the bars from becoming tangled with other bars coming through the extrusion die at the same time.

Extruded bars vary in size plus or minus 0.007 inch up to 1 inch, and plus or minus 0.015 inch for 1-inch to 2-inch sizes. On rod larger than 2 inches, the variation is as much as plus or minus 1/32 inch. Any composition that can be extruded can be forged.

Equipment for Forging Shop

Forgings are made on presses, board drop-hammers and steam hammers. The presses generally range from 100 to 600 tons, the board drop-hammers from 400 to 2000 pounds, and the steam hammers from 300 to 1500 pounds. Owing to its speed of operation, a 600-pound steam hammer will do larger work than a board drop-hammer of 500 pounds greater capacity.

Gas, oil, or electric furnaces are used to heat the forging rod and slugs. Owing to the small variation in the heat permissible to get the best results, accurate temperature controls are provided.

Preparing the Forging Blank

A properly made forging has an even density and strength in all its sections. To produce such a forging, it is necessary to roll, bend, form, draw out, or flatten the bar to such a shape that it will fill the die cavity evenly, under pressure, with a small, uniform flash around the die cavity or forging. An even flash around a forging shows that the blank is of correct shape and has uniform density and strength.

An excess of flash at one point of a forging indicates that at that point more metal has flowed into the flash than at other points; and when one section of metal flows faster than another, a weak spot develops. The unevenness of flow is more prevalent in press and board drop-hammer methods than it is in steam hammer practice.

Forging concerns that extrude their own bars turn their flashings back into bars and often allow excess flash in order to save the extra labor necessary to prepare the blank.

Hot-pressed Parts

The majority of parts made in presses are called hot-pressed parts instead of forgings. In hot-pressing, slugs are generally used. These slugs are sawed from bars of the diameter found to fill the cavity best, and of a length to suit the weight of the finished part plus a small amount for the flash. In cutting the slugs, it is necessary to take into consideration variations in the diameter of the extruded bars. An over-size slug will often crack a die or press. It is considered good practice to check the slugs by weight before hot-pressing them.

In hot-pressing, the practice is to finish the part with one stroke of the press. The unevenness of the flow of certain sections accounts for cold shuts and defects, often not discovered until the parts have been in service for months. The majority of hot-pressed parts have no greater density than extruded rod. The surface of a hot-pressed part is harder to machine than a forging. An allowance of 1/32 inch or more should be left on hot-pressed parts for machining. This extra stock is not needed on a forging.

Dies for Hot-pressed Parts

Dies for hot-pressed parts are made of high-speed steel. The proper hardening of these dies is a most important fac-

*Abstract of a paper read before a recent meeting of the National Pressed Metal Society; R. E. Servis, Secretary, 319 W. Ohio St., Chicago, Ill.

tor in the successful hot-pressing of brass or copper. If the die is too hard—say 70 to 75 scleroscope test—heat checks will result, which will gradually crack the die. Ten to twenty thousand hot-pressed parts represent the average life of a hot-pressed die. The life of hot-pressed dies as well as forging dies, depends also on the amount of work the impression has to do.

In hot-pressing, little draft is required; a part will press more easily without draft than it will with it. It is very difficult to hot-press a section beyond a tapered section; when the hot slugs reach the tapered section, the metal cools, and it is necessary to force metal through the center to fill up the sections beyond the tapered portion.

Knock-outs are provided to eject the forgings from the die cavity. If the hot-pressed part is shallow, a mechanical knock-out is used to eject the parts; if the part is of any considerable length, it is allowed to cool off a little so that it shrinks away from the die, and a foot-operated knock-out is used to eject the parts.

Hot-pressed dies are under-cut a little, the same as in die-casting practice, so that the part remains in the portion of the die with the knock-out in it. When the part is likely to stick in either the upper or the lower die, it is good practice to provide a knock-out in both dies.

Operators sometimes oil the dies with wax, kerosene or oil, so that the parts can be ejected easily. Oiling the dies is detrimental to their life; the explosion that takes place, wears the dies rapidly and the dies often crack from excessive use of oil.

Dies for Drop and Steam Hammers

Dies for board drop and steam hammers are made of a low-carbon steel. Their average life ranges from 50,000 to 150,000 forgings. This long life is made possible by spreading the operations over several sections of the die. Most dies have, in addition to the finished pair of die cavities, a roller to draw out the stock to a smaller section; a former to form it to the approximate shape of the die cavity; a blocker to prepare the bar to the approximate shape of the finished impression; and a cut-off to cut the forging off the end of bar.

Brass forging dies require approximately the same draft as dies for steel. It is possible, when the sections are not too high, to use a draft of 3 degrees instead of 5 and 7 degrees as is customary on the deeper sections. Due to the softness of brass and copper, it is of the utmost importance to smooth and polish the dies very highly. If a scratch is left, the brass is driven into this crevice, and in a short time a crack will develop.

In forging practice, the quantity of parts ordered determines the number of impressions sunk into the die, as well as the kind of material used in making the die. If the order is small, one impression is used, and the dies are made from an inexpensive grade of material. If the quantity ordered is large—25,000 or over—multiple impressions are used and a better grade of steel is employed. Forging die steel costs from 8 to 25 cents per pound. The die-blocks weigh from 150 to 500 pounds per set; hence, cheaper steel is used when the quantities are small.

Limits on Forging Dimensions

Hot-pressed parts can be held to limits of plus or minus 0.002 inch on a diameter not exceeding 1 inch. On a diameter of from 1 to 2 inches, the sizes will vary by plus or minus 0.004 inch. Smaller sections than 1 inch can be held closer. Shoulders can be held to plus or minus 0.002 inch. Forgings will vary by plus or minus 0.005 inch, on an average. If a part is 6 inches long, it will vary in length about 0.010 inch. In commercial practice, forgings may vary by plus or minus 0.0075 inch, unless otherwise specified.

Dies for Trimming the Flash

Trimming dies are used to trim the flash from forgings or hot-pressed parts. They are usually made in sections and doweled together. These die sections, as well as the die-blocks, are generally carried in stock, all planed ready for use. Trimming die and punch sections are planed in 8-foot bars and cut to length to suit the length of the part to be trimmed. Making trimming die in sections enables the toolmaker to work out the dies more quickly. With this method, he can replace a section if it breaks instead of making a new die; it also enables dies to be closed or opened up to suit the forgings. Trimming dies are usually made of oil-hardening steel.

Importance of Correct Heating

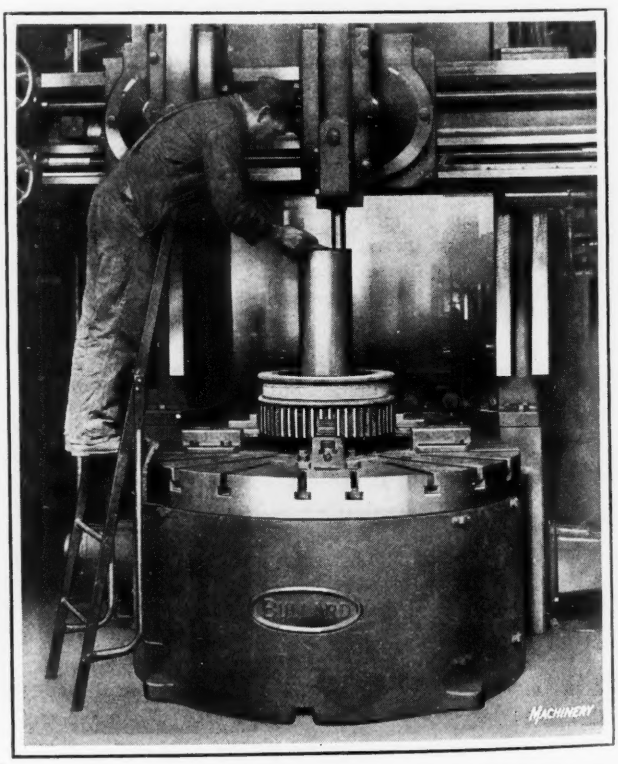
Board drop-hammers, operating at one-third the speed of steam hammers, often require two or more heats to finish a forging. The reheating of these forgings in the same furnace causes the thinner sections to heat more quickly, and when the reheated forgings are finished, strains are set up, resulting in irregular sized or crooked and faulty forgings.

Board drop-hammer men, to save reheating the forgings, often heat the rods higher than the required forging heat. This causes the bar to open up or burn, but it is impossible to detect these defects with the eye, and they are not discovered until they are machined, or until the forging is subjected to a sudden blow. Small slugs can be cut up, heated, put in a die and when pressure is applied, they will make a solid-looking forging. However, when this forging is subjected to a shock, it will break up into small sections, the same as an overheated forging. Brass is best forged with a 25-degrée limit above or below the theoretically correct temperature. With this small variation, speed is essential to prepare the bar for its finished impression. If the rod has to be bent, a short stroke will bend it; if the rod has to be rolled out, a steam hammer, adjusted for a short stroke, will tap the work six times to one stroke of the board hammer.

* * *

LADDER FOR BORING MILL OPERATOR

The portable ladder shown in the accompanying illustration, is used at the Pittsfield, Mass., plant of the General Electric Co., in connection with vertical boring mills to make it easy for the operator to reach the work and tools. The ladder raises the operator to the necessary height and gives him a firm support. A toe guard, attached to the ladder, protects the operator's feet when the mill is running. Brackets are screwed at various points around the base of the machine to support the ladder in different positions. This device is especially adapted for use with small mills.



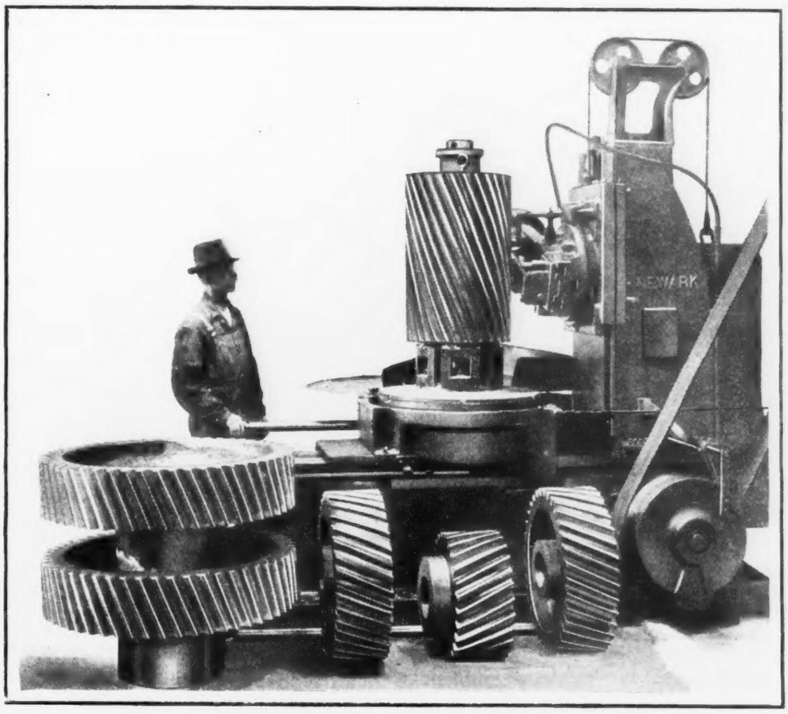
Ladder for Vertical Boring Mill, showing Operator taking Measurements

AN UNUSUAL EXAMPLE OF HELICAL GEAR HOBBING

In hobbing the helical pinion shown on the machine in the accompanying illustration, it was necessary, owing to the face width of the pinion, to reverse its position after cutting as far as possible in one direction. Notwithstanding the fact that two settings were required, the first and second cuts match so accurately that there is no measurable difference between them, the pinion being practically the same as though it had been finished at one passage of the hob. Both roughing and finishing cuts were taken, as smooth running gears were essential.

This pinion has a pitch diameter of 18 inches, a face width of 29 inches, and the teeth are 1 1/2 diametral pitch. For the first cut, the feeding movement of the hob was upward, or away from the table; then the blank was turned over to cut the remainder of the face, the hob feeding downward for the second cut, or in the usual direction.

The illustration shows other gears forming part of the train to which this wide-faced pinion belongs, all of which were cut on the machine shown. The largest gears seen at the left have 54 teeth and a pitch diameter of 36 inches; the intermediate gears have 36 teeth and a pitch diameter of 24 inches; and the smallest pinions have 27 teeth and a pitch diameter of 18 inches. All of these gears are 1 1/2 diametral pitch, and they are made of steel. The helix angle is 23 degrees, and the pressure angle is 20 degrees in the plane of rotation.



Hobbing Helical Pinion which could not be finished at One Setting owing to Face Width

The machine used is a No. 5 Newark gear-hobbing machine, built by the Newark Gear Cutting Machine Co., Newark, N. J. This machine has a differential, so that roughing and finishing cuts were taken readily, as the gear trains were not disengaged when the carriage was returned for the finishing cut. The method of gearing up the machine for a job of this kind is another point of interest. It will be noticed that the pinions and the largest gears are left-hand, whereas the intermediate gears are right-hand. It is essential, of course, for the lead or helix angle of this gear train to be accurate, in order to secure a perfect bearing along the entire tooth face.

To obtain the desired results, the machine is geared for the axial pitch or "one tooth lead," the latter being the distance from one tooth to the next, measured parallel to the axis of the gear. The machine may be geared for any one of the train of gears, and the other gears can then be cut without additional change.

Assume, for example, that it is geared for the "one tooth lead" of the 27-tooth pinion. The index gears for 27 teeth are then placed in position, which completes the setting. After these pinions are cut, if the intermediate gears having 36 teeth are to be cut, the same lead gears are used, and it is only necessary to replace the indexing change-gears for 27 teeth with those required for 36 teeth. The machine does its own multiplying of this "one tooth lead" for the various numbers of teeth, by means of the differential which is located between the indexing change-gears and the hob drive.

For cutting a gear of opposite hand, the machine is changed by shifting a lever which does not affect the lead, so that right- and left-hand gears are given the same lead. The feed may be increased, decreased, or disengaged without affecting the lead train. The gears previously referred to were cut with a high-speed steel hob of the ground type, using a hob speed of 43 revolutions, and a feed of 0.040 inch per work revolution for roughing, and a feed of 0.060 inch for finishing.

* * *

MEETING OF INTERNATIONAL ACETYLENE ASSOCIATION

The twenty-seventh convention of the International Acetylene Association was held in the Congress Hotel, Chicago, Ill., November 10, 11, and 12. Among the subjects that came before the convention were a discussion of generator construction rules, with representatives of the Underwriters' Laboratory, and a discussion of rules relating to acetylene for lighting, with representatives of the National Fire Protection Association. Papers were read by Dr. H. L. Whittemore of the Bureau of Standards, Washington, D. C., on "Testing of Welds"; by Dr. A. Krebs of the General Welding and Equipment Co., Boston, Mass., on "A Few Factors to be Considered for Accelerated Progress of the Gas Welding Industry"; by S. W. Miller of the Union Carbide & Carbon Corporation, New York City, on "The Most Important Thing in Welding"; by G. O. Carter of the Union Carbide & Carbon Corporation, New York City, on "Does Oxy-acetylene Welding Suffer from Defective Welding by Other Processes?"; by M. F. Bayer of the Simmons Co., Kenosha, Wis., on "Production Welding on Steel Furniture"; by W. C. Swift of the American Brass Co., Waterbury, Conn., on "Some Applications of Bronze Welding"; by E. E. Thum of the Union Carbide & Carbon Corporation, New York City, on "Heat-treatment by the Oxy-acetylene Flame"; by G. E. Harcke of the Air Reduction Sales Co., New York City, on "How the Moving Picture is Educating the Public and the User"; by L. F. Hagglund of the Underwater Metal Cutting Corporation, New York City, on "Underwater Metal Cutting."

* * *

COMMERCIAL GUIDE BOOK TO THE FAR EAST

The Department of Commerce has published a guide book for commercial travelers in the Far East which should prove of great value to those whom business calls upon to travel in that part of the world. The guide book contains nearly 400 pages, with maps of all the important countries, and is a comprehensive and detailed guide of the principal trading areas of the Far East, including Australia. The exact title of the work is "The Commercial Travelers' Guide to the Far East," and is published as Trade Promotion Series No. 29. Copies may be obtained from any district office of the Bureau of Foreign and Domestic Commerce, or direct from the Superintendent of Documents, Government Printing Office, Washington, D. C. The price is 85 cents.

WASTE DUE TO INEFFICIENT HANDLING OF MATERIALS

A paper entitled "Industry's Annual Tax for Materials Handling and Suggestions for its Elimination" will be read by Harold V. Coes, vice-president and general manager of the Belden Mfg. Co., Chicago, Ill., before the annual meeting of the American Society of Mechanical Engineers to be held in the Engineering Societies' Building, New York City, December 6 to 9. In this paper, Mr. Coes points out how the national bill for handling materials can be reduced a billion dollars a year by making the proper use of equipment now available, and by the relocation of stock-rooms and proper coordination of production with equipment for moving materials.

Mr. Coes states that industry is annually spending millions of dollars for labor that could be better, more efficiently, and less expensively done by materials-handling equipment. The total annual payroll of American manufacturing, according to the latest census available—that of 1923—was $14,017,107,000. A survey made for a leading trade paper indicates that the materials-handling labor cost of American industries in this annual payroll was approximately 22 per cent of this amount, or $3,084,000,000.

It is the author's belief that the use of materials-handling equipment available in the present state of the art, together with rearrangement of equipment, relocation of stock-rooms, proper coordination of production with materials-handling equipment systems, and adequate plans for procedure and operation in this coordination would reduce this at least to $2,000,000,000, releasing the recipients of $1,084,000,000 of payroll from back-breaking, nerve-racking, fatiguing work to be employed in more pleasant, less exhausting places, in other phases of industry, or in industries not started, but awaiting the labor to develop them.

What Adequate Materials-handling Equipment Would Save

If we assume the average annual wage for this class of work at $1000, then the labor released would be 1,084,000 workers. Suppose we exercise our imagination and, to be reasonably conservative, assume that to release this labor we must invest its equivalent annual rate for one year in materials-handling equipment; now what have we done to the annual American industrial balance sheet?

We have transferred an annual expense of $1,084,000,000 from our overhead to our assets, as represented by the $1,084,000,000 invested in equipment, etc. The annual bill for fixed charges and operating expenses would probably not be, on the most conservative basis, over 33 per cent of the initial investment, or $361,300,000; so our national industrial balance sheet would show overhead reduced from $3,084,000,000 to $2,361,300,000, and our capital account increased by $1,084,000,000. The entire investment would probably be paid for out of earnings, that is, net savings in labor expense, in from four and one-half to five years, as an average. This is not an impossible program at all. Does this not appear to be a real opportunity for the engineer? Is it not apparent that we have not even scratched the surface as yet?

One of the reasons why industry is paying for materials-handling equipment by means of the payroll is the fact that a yearly payroll is paid out monthly, semi-monthly, or weekly, as the case may be, but a bill or statement for a piece of equipment shows up as one lump sum; unless the facts are uncovered with a suitable means of evaluating them and a comparative economic measure obtained, the real economies are not apparent and therefore not sought for.

It is amazing how many places there are in an industrial plant where careful studies of materials handling reveal literally gold mines. A manufacturer will spend thousands on new productive equipment that in many instances reduces the prime cost per unit produced a comparatively small amount. In many instances, this is entirely legitimate, but he should not overlook the greater opportunities of reducing the overhead by efficient materials-handling equipment.

It is generally acknowledged that a very large percentage of the cost in any completed article is represented by moving it from place to place—either from locality to locality or from point to point within a plant. It is, therefore, of prime importance to make detailed analyses and an assemblage of cost figures to determine just what the materials-handling expenses under the prevailing methods are. This being done, it is possible to consider how much labor may be saved by the adaptation of standard equipment already available on the market.

An Example that Shows what can be Accomplished

The company with which the author is connected has installed a number of materials-handling systems during the last two years. The author points out that the total cost of installing these systems was $19,611. The annual labor saving is practically equal to the total cost of the equipment installed, or $19,800. On the other hand, power to operate the systems costs $400 a year, and the fixed charges on the installed equipment amount to $6950 annually. There were no fixed charges on any replaced equipment, because in every case, hand labor was replaced by mechanical means.

It is interesting to note that the maximum investment which would have broken even with hand labor, would have been nearly $63,000, or more than three times the actual investment. The yearly profit on the investment resulting from the operation of this equipment is actually $12,450, or nearly 70 per cent of the investment. It is evident that the equipment pays for itself completely in considerably less than two years, even when no account is taken of the increase in production resulting from the use of this equipment. The installation, however, has made it possible to speed up shipments and to give better service.

* * *

SPECIAL EXTENSIONS OF PATENT RIGHTS OBJECTIONABLE

A bill was introduced in the House and Senate last spring known as S-4480, the object of which is to provide for the extension of the time limit under which patents are issued in the case of persons who served in the armed forces of the United States during the World War. The bill provides for an extension of such patents for a term equal to three times the length of the patentee's service in the armed forces of the United States.

It is proper that the nation should show its appreciation to those who fought for it during the World War, in every legitimate way, but the extension of patent rights is a very objectionable method. Endless confusion will result if Congress begins to extend patent protection to a selected group of patentees. The matter of patents is so far removed from what may be considered a legitimate method of national recognition of the services of the men who fought in the World War that this bill ought not to pass. There are sufficient difficulties to be encountered in connection with our patent laws as it is, without complicating them by the additional confusion that would result from arbitrary extensions of patent protection of this kind.

* * *

INTERNATIONAL ENGINEERING MEETING PLANNED IN JAPAN

An invitation has been tendered by Dr. M. Kamo, dean of mechanical engineering at the Imperial University of Tokyo, Japan, and president of the Society of Mechanical Engineers of Japan, to the engineering societies of the United States to take part in an International Engineering Congress in Japan in 1929. The Japanese Government has passed a bill appropriating funds to assist in defraying the expenses of the congress, and formal invitations are soon expected by the leading engineering societies in the United States. Secretary Hoover, as well as many leading engineers of this country, have expressed themselves as favorable to holding such a congress, and are supporting the efforts that are being made to assure a representative attendance from the United States.

VANADIUM

Vanadium is a light colored metal having a specific gravity of from 5.5 to 6. It melts at a temperature of 1750 degrees C. (3182 degrees F.). Its specific heat at 32 degrees F. is 0.124, and its electrical conductivity (silver = 100) is about 5; it is non-magnetic. Vanadium is widely distributed in small quantities in a large number of minerals. It is an important alloying metal used in steel, vanadium steel having a number of valuable properties which are not obtainable in ordinary steel. On account of its great affinity for carbon, oxygen, and nitrogen at high temperatures, absolutely pure vanadium has not been produced. Owing to its very high melting point, vanadium, even if it were commercially possible to produce it reasonably pure in the metallic state, would present much difficulty in alloying with other metals. Fortunately, it is relatively easy to reduce vanadium as an alloy of iron, ferro-vanadium, containing approximately one part of vanadium and two parts of iron. This alloy has a melting point of about 1300 degrees C. (about 2370 degrees F.), which is low enough for it to melt and alloy readily when added to molten steel.

ZINC CASTINGS

Pure zinc castings are used for certain special purposes. For example, the dies or blocks on which hats are made are usually cast from zinc. The patterns for pure zinc castings are usually made from plaster-of-paris, and the molding is similar to that of other metals. Another use for cast zinc is for making monuments and statues, the metal then being marketed under the name of "white bronze." For many purposes of inside decoration, a metal casting that can be easily bronzed or otherwise finished is desirable. Zinc, when alloyed with some copper, is frequently used, although, as a general rule, brass or bronze castings are preferable. Brass and bronze, however, must be cast at a temperature of from 1700 to 1900 degrees F., according to the composition of the alloy, whereas zinc, alloyed with a small amount of copper, can be cast at a temperature of from about 800 to 900 degrees F., which is an important consideration, especially when plaster molds are used. If the zinc castings are large and are to be used for monuments or statues, they are generally cast in sections in sand, and the sections are subsequently brazed together.

NICKEL STEEL

Nickel steel is used to a large extent in the construction of high-grade machinery, and can be purchased in the open market in almost any percentages of nickel up to 35 per cent, and with the carbon component varying between 0.10 and 1 per cent. If nickel is added to steel in any percentage not exceeding 8 per cent, the tensile strength and the elastic limit of the steel will increase with the percentage of nickel. If the percentage of nickel is above 8 per cent, but less than 15 per cent, its effect on the steel becomes entirely neutralized and brittleness is produced. If the nickel percentage, however, is above 15 per cent, then the strength and elasticity become practically equal to that of the nickel steels with percentages of nickel less than 8 per cent. If the nickel percentage is increased above 20 per cent, the strength and elastic limit gradually decrease, but the elongation increases. The United States Navy Department specifications for hot-rolled or forged nickel steel require the carbon content to be from 0.25 to 0.35 per cent, and the nickel, from 3 to 3.5 per cent, with neither the sulphur nor the phosphorus exceeding 0.04 per cent.

INVAR

Invar is a nickel steel containing about 36 per cent nickel, together with about 0.5 per cent each of carbon and manganese, with metallurgically negligible quantities of sulphur, phosphorus, and other elements, the remainder being iron. It is made either in the open-hearth furnace or by the crucible method. It melts at about 1425 degrees C. (about 2600 degrees F.). The value of this alloy lies in the fact that it has a very small coefficient of expansion due to heat, and it is, therefore, used in scientific instruments, for standard length measurements, and in high-grade measuring tapes. It may also be used in incandescent electric lamps for the wire connections which are fused into the glass. Invar can be forged, rolled, turned, filed, and drawn into wires; and it takes a beautiful polish. In general, it should be worked slowly. It will withstand the corrosive action of water without spotting, even when immersed for several days. Its specific gravity is about 8; its electrical resistivity is about 8 times that of pure iron; and its temperature coefficient of electrical resistance about 0.0012 per degree C. It is ferro-magnetic, but becomes paramagnetic in the neighborhood of 165 degrees C. (about 330 degrees F.). The mechanical properties are about as follows: Tensile strength, 50,000 to 85,000 pounds per square inch; elastic limit, 7000 to 30,000 pounds per square inch; elongation, 40 to 50 per cent; reduction of area, 40 to 65 per cent; scleroscope hardness, 19; and Brinell hardness, 160.

VACUUM IN CONDENSER

The vacuum attainable in a condenser is dependent on the temperature of the circulating water available. The average temperature of the water for a period of four or six weeks during the hot season might be taken as the governing temperature for determining the vacuum to be maintained; then, with colder water, the vacuum will improve. For preliminary considerations, the highest vacuum that may be expected ranges from about 27 inches for a circulating water temperature of 95 degrees F. to 29 inches for a water temperature of 60 degrees F. A condensing turbine will have a steam consumption of about one-half that of a non-condensing turbine, and the power consumption of the condenser auxiliaries will be approximately 5 per cent of the steam supplied to the condensing turbines. The initial cost of the condensing equipment is more than offset by the cost of the additional boilers required for the larger steam production to supply non-condensing turbines.

VIBRATION DUE TO INTERMITTENT STEAM FLOW

Steam, when flowing at a high velocity in the supply pipe of a high-speed engine, is alternately stopped and raised again to this high velocity several hundred times a minute, due to the rapid opening and closing of the steam valves. This intermittent motion of the steam has, in many cases, been found to cause vibration in the engine supply pipe, which, in turn, is transmitted to other branches of the system. Vibration is also caused by suddenly changing the direction of steam flow through tees and short-turn elbows, and sometimes by the unequal velocity of steam flowing through different branches of the piping system. Vibration, combined with expansion and contraction strains, is a constant source of danger. The pipe should be so proportioned that the velocity will be as nearly uniform as possible in all branches of the system. The engines should be equipped with steam separators of large capacity to cushion the steam, at or near the engine throttle, and the piping should be firmly anchored at suitable points.

Interesting Engineering Items Arranged in Compact Time-saving Form

The Machine-building Industries

WITH but one month of 1926 still to be accounted for, and with industry and commerce in the same active state as during the early part of the year, it is possible at this moment to record larger production in almost every field of industry in 1926 than in any previous year; the present year has, on the whole, been most satisfactory in practically every branch of industrial endeavor. The absence of boom conditions—excessive increases in prices, reckless buying for future requirements, undue accumulation of inventories, and abuse of credit—has characterized the business of the year. Employment has been general in most industries, at wages that have maintained their ratio to the cost of living; hence, buying power has reached a high level. Absence of serious labor disturbances, strikes, and threats of strikes has also aided in maintaining the purchasing power of labor, and hence, has kept the industrial wheels running at full speed.

The ability of American industry to pass through so satisfactory a business year without entering upon a boom has made many business men feel that in the future we will be able to avoid the extreme peaks and valleys in business and industry through the application of saner and more conservative business judgment. Judge Gary, on the eve of his eightieth birthday, said: "I am becoming more and more convinced that there is no necessity for any important slump in the business of this country at any time." Judge Gary is one of many observers who have come to the conclusion that in this country we have overcome the serious effects of the business cycle.

It is a good idea to keep in mind that the ups and downs in business depend largely upon acts over which the business community has full control, but it is best not to become overconfident in regard to our ability to avoid marked fluctuations in the future. The very moment that we become overconfident, we are likely to forget the lessons taught by former business booms and depressions, and as soon as we do that, we are inviting a new "cycle." Neither booms nor depressions come when business men are fully prepared for these events. It is over-confidence, on the one hand, and excessive fear on the other, that are at the bottom of these recurring business cycles. So long as those who control American industry maintain the balanced judgment that they have so largely shown during the year soon coming to a close, stability of business is almost a foregone conclusion.

The Present Trend of Business is Inspiring Confidence

According to the reports of both financial and industrial authorities, the general business situation at the present time is above the average for this time of the year, with indications pointing to continued activity for several months to come. Business has continued good in nearly all of the basic lines, statistical information available from the steel, textile, oil, building, and railroad fields being indicative of continued and, in some cases, increasing activity. Owing to the seasonal decline in the automobile and the farm implement industries, new orders for steel are not so large as earlier in the year, but on the other hand, the railroads have entered the steel market, and the demand for structural steel continues at a satisfactory rate. The only large industry that has been operating at a slow pace during the year has been the textile industry, and it is, therefore, noteworthy that the cotton mills are now operating at their best pace for the year.

Freight loadings continue to break former records, but the railroads are prepared to handle the traffic, and no car shortage or congestion is in evidence. Unusually heavy snowstorms during the winter may, of course, create temporary difficulties in certain sections, but from causes not within the control of railroad managements. The foreign trade shows a considerable increase, and altogether, as long as conservative business judgment prevails, the present pace of industry should be practically maintained.

Conditions in the Iron and Steel and Machine Tool Industries

There has been a slight, but not very important, slowing down in the pace of the iron and steel industry. At the end of October, the United States Steel Corporation still operated at slightly over 83 per cent of capacity, the Bethlehem Steel Co. at somewhat over 80 per cent, and the other independent companies at rates closely approximating these. The steel output for the year will be larger than for any year in the history of the business, larger even than during the war years. It is further stated that the consumption of steel is proceeding at a faster rate than present buying, the operations of manufacturing plants being sustained by the heavy purchases in August and September; hence, renewed buying must soon take place. Price increases in certain lines of iron and steel should be recorded, rising fuel costs being a factor in production. Pig iron also shows a tendency to advance in price. Increased buying by the Ford Motor Co. is taken as a confirmation of the report that Ford is about to put out a new car.

No appreciable change has taken place in the machine tool industry from the conditions recorded last month. Most manufacturers state that they are receiving orders at a satisfactory rate, the plants operating not necessarily at full capacity, but at as large a percentage of capacity as is possible with the machinists available having satisfactory experience on this class of work.

The Automobile Industry Slows Down as Usual at This Season

After having maintained a rather high output during October, the present operations of many of the leading automobile plants are somewhat below the seasonal average. This is said to be due particularly to the speed with which dealers were stocked up a few months ago during the high-rate production of this year's models. Sales in most places, however, are reported as high as could be expected at this time of the year. The industry as a whole is in a satisfactory condition, and the seasonal recession may be considered as normal. There are some rumors of further price reductions, though some automobile authorities state that it is difficult to see how such a reduction could be justified by the economic situation at the present time.

The Railroads Continue to Do a Record Business

The railroads have set a new high mark in car loadings by exceeding 1,210,000 cars loaded with revenue freight in one week. At the same time, they report 87,000 surplus freight cars in good repair and immediately available for service. During the first nine months of the year, for which statistics are now available, the railroads installed in service 1664 locomotives and 85,383 freight cars. In addition, there were 443 locomotives and 16,800 freight cars on order.

It is highly creditable to the railroad managements that this year's record volume of freight has been handled with great efficiency, the railroads meanwhile making the highest average earnings in their history. There has been a marked improvement in the efficiency of freight movements. During the month of August, the last month for which figures are available, the average freight car movement was 31.5 miles per day, the highest for any August on record, and an increase of 2 miles over August last year.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

MOLINE AUTOMATIC CYLINDER LAPPING MACHINE

The latest automobile cylinder lapping machine developed by the Moline Tool Co., Moline, Ill., was designed with a view to making the operation as nearly automatic as possible. From Figs. 1 and 2 it will be obvious that the table and work-holding jig remain stationary during an operation and that the spindle-head rail and slide reciprocate vertically. One of the particular features is that the machine stops automatically after the slide and rail have made a predetermined number of strokes. Four-cylinder blocks are handled with the equipment shown; however, a sufficient number of spindles and suitable jigs can be provided for lapping six- or eight-cylinder blocks.

The machine is started by shifting lever *P*. As this is done, the lapping tools start rotating and descend into the working position, where they reciprocate the predetermined number of strokes and then return to the starting position, at which point the machine stops; thus the entire cycle is accomplished automatically. The large base is used as a settling tank or reservoir for kerosene or compound, holding about two barrels of liquid. A pump and piping system furnish a steady flow of the compound to the lapping tools.

The work-holding jig is built integral with a pan table that collects the compound and returns it into the two drawers *A*. From these drawers, the compound drains into the first compartment of the base and then overflows into successive compartments until it reaches the one from which it is repumped to the laps. Most of the grit and dirt is caught in the drawers, which can be readily removed for cleaning.

The cylinder block is slid endwise into the jig and located by disappearing pins, which are operated by lever *B*. The block is clamped in position by handwheels *C*. The upper part of the jig is provided with retainer bushings, which hold the laps in a closed position and guide them into the cylinder bores. The main drive pulley *D* is driven either from a line-shaft or from a motor mounted on the base. From the main drive shaft, power is transmitted by belt to the spiral shaft *E*, which, in turn, drives all the spindles. Pulley *F* is equipped with a clutch which is operated from the other side of the machine.

Power for reciprocating the spindle-head slide and rail is taken from the right-hand end of the shaft on which pulley *F* is mounted and delivered through gearing to shaft *G*, Fig. 2. The driven gear is provided with a positive clutch, so mounted that reciprocation can be obtained independently of rotation.

Extending through the column, there is a large drum, one end of which is indicated at *H*, Fig. 1. Plunger *J*, Fig. 2, which is operated lengthwise by means of spool *K*, runs through the center of this drum. A hole is bored in the left-hand end of the drum, 3 inches off center, and the hub of crank disk *L* rotates in this hole. The crank disk actuates connecting-rod *M* which pivots on crankpin *S*. On the short end of the connecting-rod there is a plunger *N*. The long end is fastened to a rocker arm which actuates screw *O* to move the spindle-head slide up and down.

With the spindles in the extreme upper position, lever *P* is shifted to bring the spindles and lapping tools into the working position. Then as crank disk *L* revolves, plunger *N* enters a hole bored 3 inches off center in the disk, thus locking the connecting-rod and the disk together and making the axis of the disk the center of rotation. This gives the rail a short working stroke, and with each stroke, ratchet *Q* is indexed a fraction of a revolution, the amount depending

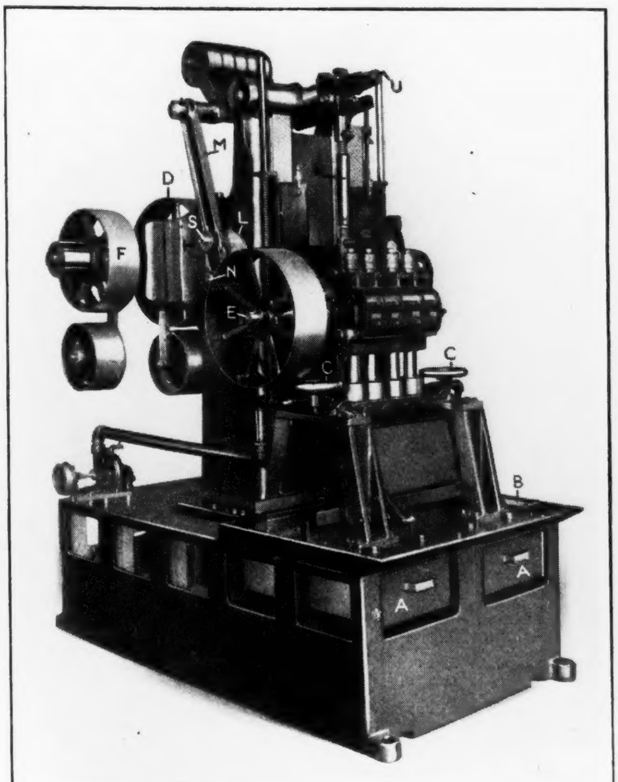


Fig. 1. Moline Automatic Multiple-spindle Cylinder Lapping Machine

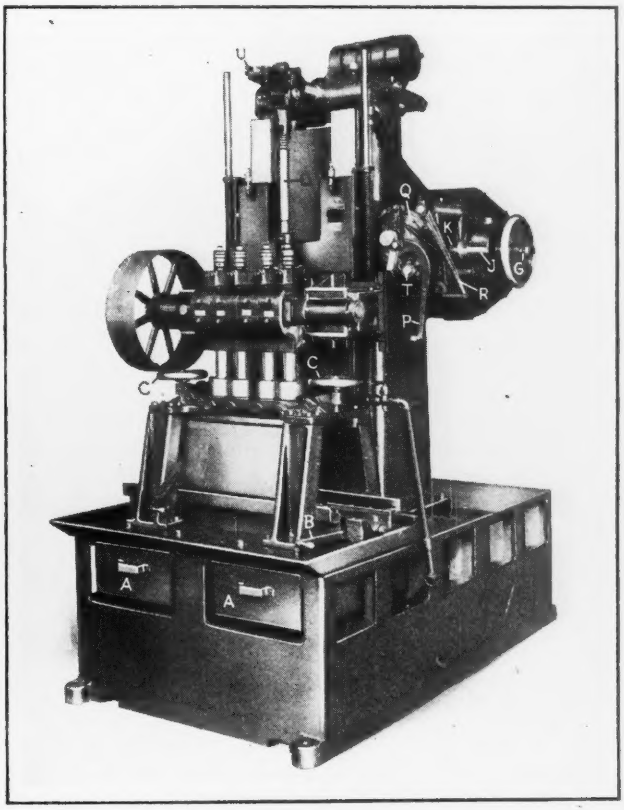
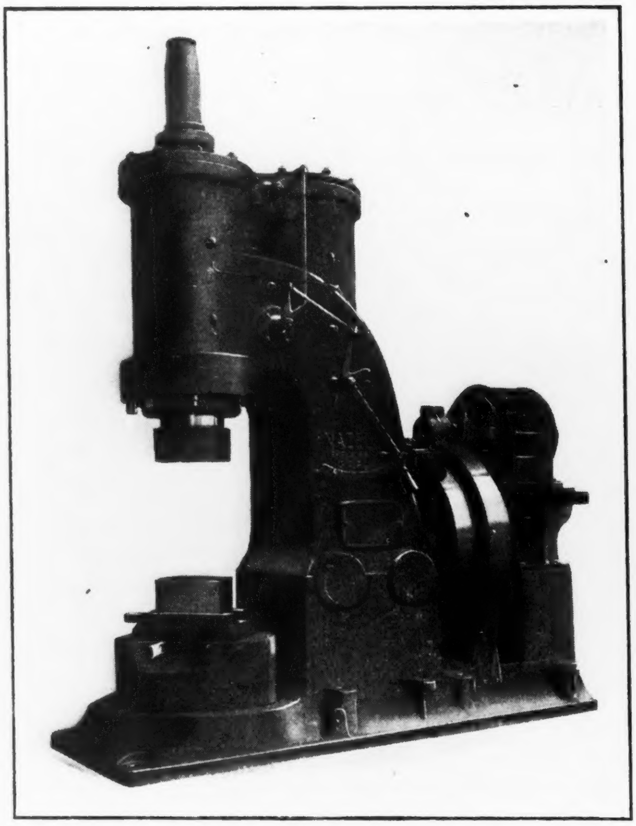


Fig. 2. View of Machine showing Reciprocation Control Unit

upon the predetermined number of strokes.

Ratchet Q is mounted on a cam plate, and with each revolution of the ratchet, the cam also revolves. When a low spot on this cam reaches a roller fastened to lever R, the lever automatically shifts spool K to force plunger N out of the hole in the crank disk and to bring the left-hand end of plunger J into this hole. The crank disk and drum H are then locked together, the pivoting point of the crank is on the crank-pin S, and the axis of rotation coincides with the center of the drum. This gives connecting-rod M an increased travel for withdrawing the tools from the work. When the spindle-head slide reaches the extreme upper position, shaft T is turned a fraction of a revolution to disengage the clutch on the main drive shaft which drives the spindles, and also the clutch on shaft G which controls the spindle slide reciprocation. The machine then stops until lever P is again shifted by the operator.



Nazel Hammer designed to permit the Use of Long Ram Dies

The length of the working stroke is adjustable from 4 to 6 1/2 inches through screw U, and the position of the spindle-head slide can be adjusted by means of screw O. The slide is balanced by counterweights and by springs so as to provide an easy motion. All reciprocating parts, such as the rail, slide, and spindle heads, are made of aluminum to give minimum weight.

NAZEL SPECIAL AIR HAMMER

Larger ram dies than can be accommodated on the regular type B air hammer built by the Nazel Engineering & Machine Works, 4043 N. 5th St., Philadelphia, Pa., can be employed in a special machine of this type which has recently been constructed. The distance between the dies of the special machine with the ram suspended is 27 3/4 inches. Dies of any dimensions can be used, provided their weight is within the lifting power of the hammer. The machine is especially adapted to the production of forgings requiring the use of long special dies.

Automatic lubrication is supplied to all working parts by means of a forced feed lubrication. Variable blows can be obtained at the will of the operator without interruptions or changes of speed. One hundred and twenty blows can be struck per minute. The hammer, air compressor, and motor form a complete self-contained unit, which occupies a small amount of floor space. A 40-horsepower motor is recommended. Stock up to 8 inches square can be handled efficiently.

NORTON TOOL AND CUTTER GRINDING MACHINE

The larger of the universal tool and cutter grinding machines which have been built for years by the Norton Co., Worcester, Mass., has recently been redesigned and arranged with a complete self-contained motor drive. Individual motors have been built into each operating unit, and the result is a machine efficient in power delivered and easy of operation. Three motors provide power for the various units.

The double-end wheel-spindle is driven by a 1/2-horsepower constant-speed motor mounted on a platform in the base of the machine, as illustrated in Fig. 3. The platform is attached to the wheel column and holds the motor at all times

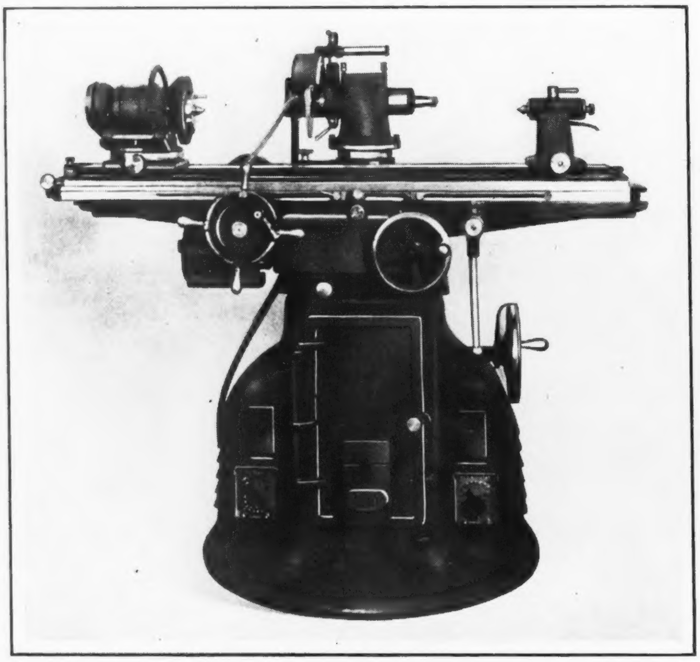


Fig. 1. Norton Universal Tool and Cutter Grinding Machine with an Individual Motor for Each Operating Unit

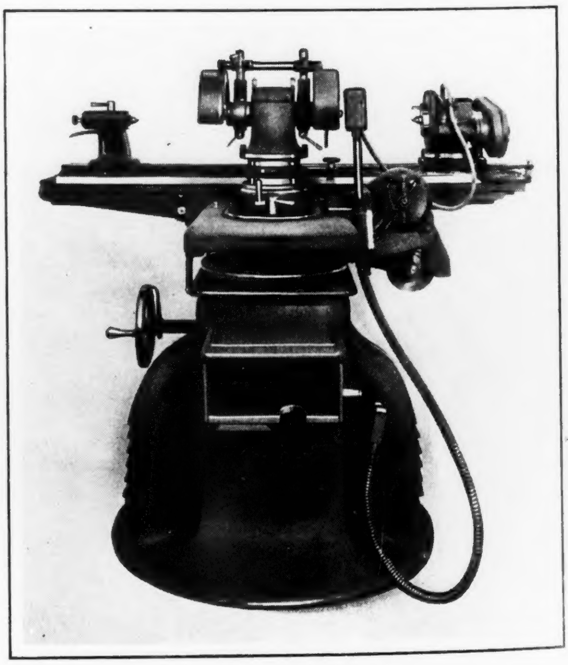


Fig. 2. Rear View of Complete Motor-driven Universal Tool and Cutter Grinding Machine

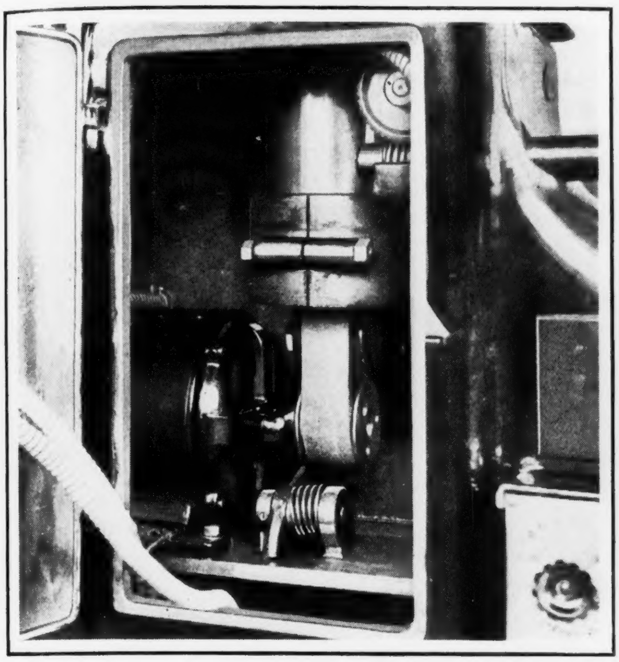


Fig. 3. Wheel-driving Motor mounted in Base of Machine

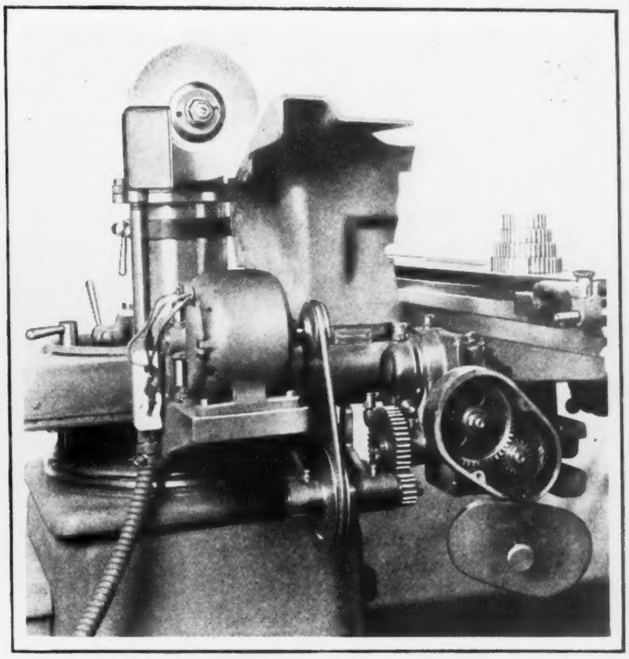


Fig. 4. Table Traverse Mechanism and its Driving Motor

in the same relation to the wheel-spindle. The belt passes through the hollow column and is thus completely guarded. A spring idler maintains the desired belt tension, as may be seen. For starting and stopping this motor, there is a switch control located on the door at the front of the base.

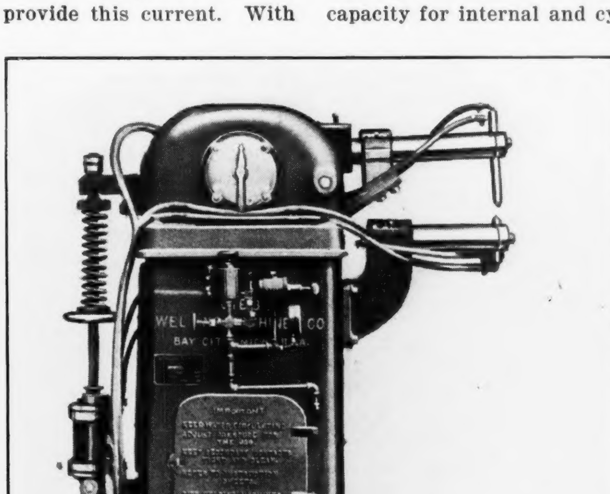
The headstock is equipped with a 1/20-horsepower adjustable-speed direct-current motor, which provides work speeds ranging from approximately 200 to 350 revolutions per minute. A field rheostat on the base of the machine controls these speeds, while a push-button switch governs the starting and stopping of the motor. The traverse of the table is automatically effected by a 1/8-horsepower adjustable-speed direct-current motor built into the traverse mechanism. Fig. 4 shows this drive with the gear covers removed. Variations in the speed of this motor are also controlled by a field rheostat attached to the front of the base. Change-gears provide a power traverse speed ranging from approximately 70 to 392 inches per minute.

When direct-current is not available for the adjustable-speed headstock and table-traverse motors, a generator is installed in the machine base to provide this current. With this arrangement, a 1-horsepower motor replaces the smaller motor regularly used for the wheel drive, and the generator is coupled direct to the shaft of this motor.

In redesigning this machine, the length of the table was increased to permit work 36 inches long to be mounted between centers, and to provide a table traverse of 32 inches for both cylindrical and surface grinding operations. The cross-feed of the table is 8 1/8 inches and an 8-inch vertical movement of the wheel column is possible. Work 12 inches in diameter may be swung on the headstock and footstock centers, and face cutters or similar tools up to 14 inches in diameter can be ground by letting them project over the edge of the table.

Another new feature of the machine is the introduction of a lever for moving the table short strokes. The long leverage and handy position of this lever provide the operator with a means of easily moving the work past the wheel in cutter and tool sharpening operations. For a longer hand traverse, a pilot handwheel is used to obtain either a fast or slow speed to suit the grinding requirements. Adaptability of the machine to a wide variety of work is assured through the adjustments possible in the setting of the tables, the height of the wheel-head, and the universal fixture supplied. The table can be swung through a distance of 150 degrees to permit setting it in any desired position relative to the grinding wheels. For taper-grinding, the swivel table is pivoted the required amount by means of a delicate adjustment or, when holding work on a faceplate or chuck, the headstock is swiveled to obtain the taper.

Fixtures, wheels, and wheel mounts are provided to take care of tool sharpening and light manufacturing work. The fixtures include a combination attachment adapted to a variety of tool sharpening operations, a universal vise used for holding work in surface grinding, a three-jaw chuck of 6-inch capacity for internal and cylindrical grinding operations, an internal grinding spindle, a center rest, and tooth rests.



Gibb "Hi-Speed" Spot Welding Machine operated by Air

"HI-SPEED" SPOT WELDER

Uniformity of heat, pressure, and time, and, as a result, uniformity of welds, are advantages claimed for a "Hi-Speed" air-operated spot welder recently developed by the Gibb Welding Machines Co., Bay City, Mich. Ease and rapidity of operation are also pointed out as features of this equipment. From the illustration, it will be seen that the machine is of simple design. There is a lever arm, on the front end of which one electrode and the secondary connection are fastened. To the rear end of this arm is attached a piston-rod, which is equipped with a large compression spring. The air cylinder is mounted on a ful-

crum, and maintains alignment with the swiveling upper arm at all times. The cylinder is 3 1/2 inches in diameter, and its piston has a 3 1/2-inch stroke. The leverage of the upper arm, with standard arm lengths, is approximately 2 to 1, giving a stroke about 1 3/4 inches long at the electrodes.

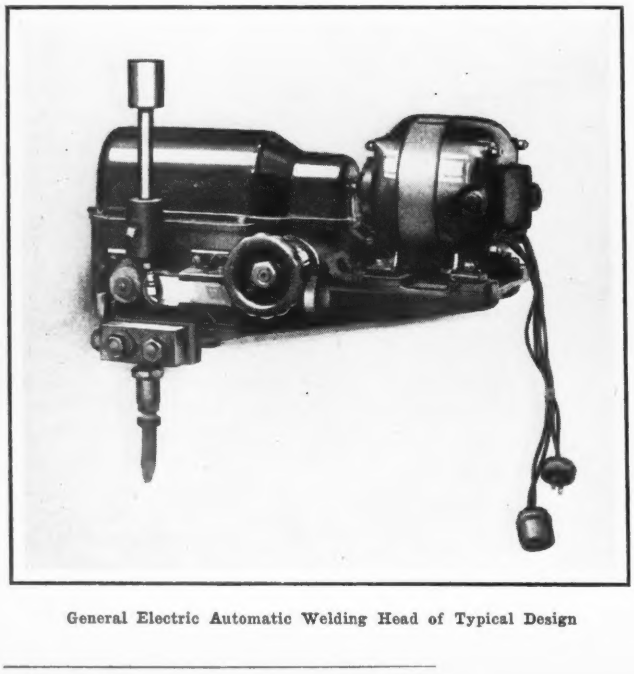
A regulating valve enables the welding pressure to be varied from 10 to 100 pounds, depending upon the work and the available air supply. Further adjustment of the pressure is obtainable through the compression spring. The design of the foot-valve permits the machine to be actuated by a small stroke, and the treadle is close to the floor to facilitate the operation. An automatic remote control switch on the treadle operates a magnetic switch within the base. Various heats for different gages of material are obtainable through a 6-point heat regulator. Stock varying from light sheets up to and including two sheets of No. 7 gage, or equivalent thickness, can be welded.

The machine is regularly built with various throat depths up to 24 inches, but it can be supplied with an even greater throat depth. It can also be furnished with an attachment for foot operation without air, if desired, thus providing against loss of production through temporary failure of the air supply. The weight of the machine is approximately 1800 pounds.

GENERAL ELECTRIC AUTOMATIC WELDER

With a new design of automatic arc welder being introduced on the market by the General Electric Co., Schenectady, N. Y., the operator need only push a button to start the sequence of operations, the weld being produced without any further effort or skill on his part. The arc is started by first touching the electrode to the work and then withdrawing it, after which a constant arc length is maintained by feeding the electrode wire to the weld at the rate of speed necessary to replace the electrode fused into the weld. It is claimed that the new equipment will perform these operations more rapidly and with a greater degree of accuracy than is possible by expert hand operators.

The automatic welding head incorporates the necessary mechanism for feeding the electrode to the arc, and consists essentially of a pair of feed rollers which are geared to a constant-speed motor through a magnetic clutch. The gearing and feed mechanism are contained in one housing to which the motor is bolted. The rollers feed the welding wire through the nozzle to the arc, and the distance and pressure between the rollers is readily adjustable. Each welding head is equipped with a set of nozzles for 3/32-, 1/8-, 5/32-, 3/16-, and 1/4-inch wire. Through the provision of three gear speed changes, the speed of the feed rollers can be adapted to the size of wire and to the welding current used. A finer adjustment can be made by means of a rheostat in the field of the motor.



General Electric Automatic Welding Head of Typical Design

Provision is made for pointing the electrode backward or forward in the line of weld and also for moving it sidewise. The pointing of the electrode is accomplished by rotating the head on the horizontal shaft, and the lateral movement, by means of the handwheel on the front of the head. The control equipment consists of a control panel, a meter panel, and a push-button station. The magnetic clutch is operated forward or backward by a voltage relay, the coil of which is connected across the arc. The electrode is fed to or from the work automatically, adjusting itself to any irregularities in the surface of the work. One rheostat controls the speed of the feed motor, and another, the voltage setting of the arc. This new automatic arc welder will find its principal application in the construction of such standard products as pipe, tanks, boilers, cans, and automobile axle housings, where the operation is on a production schedule.

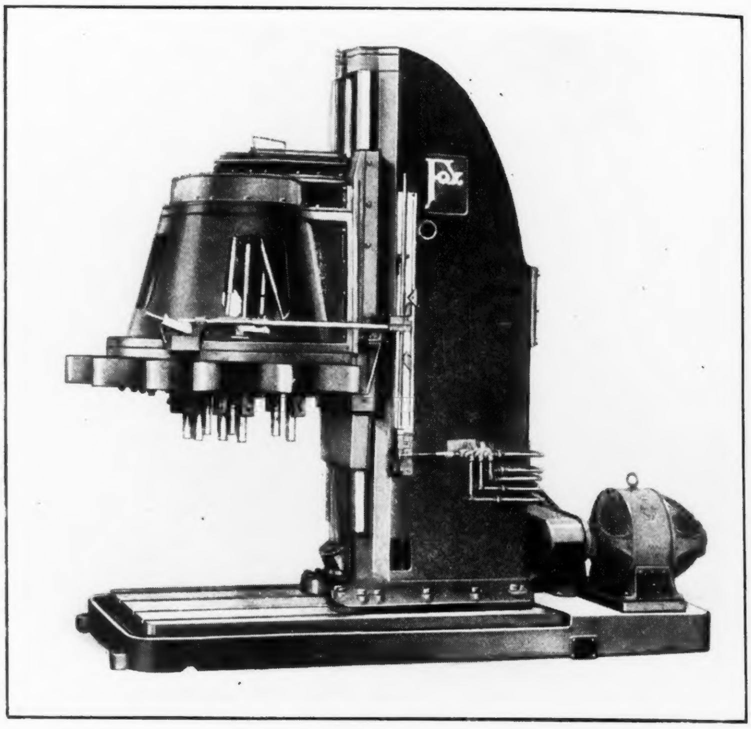


Fig. 1. Fox Heavy-duty Multiple-spindle Drilling Machine

FOX MULTIPLE-SPINDLE DRILLING MACHINE

Feeding of the drilling head on the latest 33-HC heavy-duty multiple-spindle drilling machine built by the Fox Machine Co., Jackson, Mich., is accomplished by means of an Oilgear feed-pump. This arrangement has resulted in a machine of unusually simple construction. With the exception of the Oilgear pump, all units are built into the machine. It will be observed from the illustrations that the customary drive shaft projecting above and traveling with the drilling head is not required. The drive to the machine may be by either a countershaft or a motor, as in the case of the machine shown. The motor drives through an enclosed silent chain.

Power is delivered to a gear-box located in the base of the column, this gear-box being a unit in itself that can be easily removed when the occasion demands. A sliding gear trans-

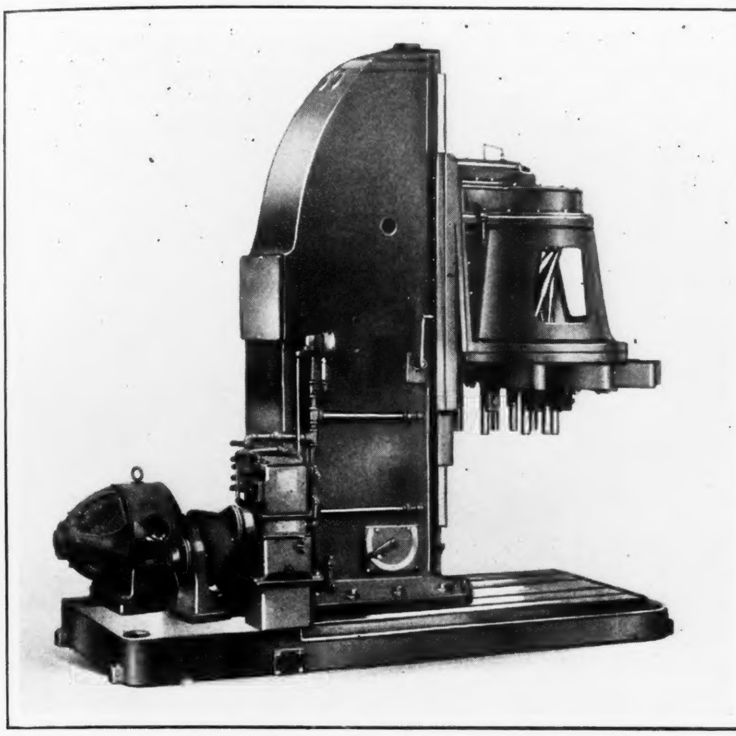


Fig. 2. Oilgear Pump, and Motor Drive as seen from Left-hand Side of Machine

mission permits the selection of one of three speeds for the drill spindles. At the front end of the gear-box there is a set of spiral bevel gears which transmit the drive to a vertical double-splined shaft located in a recess in the face of the column. This shaft has no longitudinal movement. A gear on the drilling head is equipped with keys that engage with the splines in the vertical shaft, and the drive to the drill-spindle pinions is accomplished through idler gears mounted in ball bearings.

The hydraulic feed cylinder is located in the column recess directly behind the vertical drive shaft, where it is readily accessible by simply removing sliding sheet-metal covers. The machine column is built to take a feed cylinder that permits a stroke of 12 inches, which is more than sufficient for most drilling jobs. There is provision, however, for accommodating an 18-inch stroke cylinder. The feed-pipes that supply oil to the cylinder pass through the side of the column and have pipe unions so located that they can be easily disconnected when removing a cylinder.

The ram of the feed cylinder is of special construction, and has square threads which engage a nut held against rotation by the head saddle. The upper end of the ram telescopes in a sleeve suspended from the top cover of the column, as the head feeds up and down, the ram and sleeve being keyed together. The sleeve can be rotated by turning a crank on the left-hand side of the column, to adjust the head to any desired position on the column. The drilling head movement produced by the hydraulic cylinder is 12 inches.

The Oilgear pump is driven from the drive shaft by a silent chain. It imparts a rapid travel to the drilling head in either direction, and the drilling feed may be adjusted to any desired rate. Adjustable stops on the right-hand side of the column regulate the amount of rapid head movement and the depth of drilling. There is a fine adjustment for drilling depth, which is useful in drilling blind holes.

A manual feed control handle is located on the right-hand side of the drilling head. By moving this handle to produce the rapid travel downward, the operator completes his part in executing a drilling cycle. At any time during the cycle, however, he can use the same handle to stop or reverse the feed of the head. The handle can be locked in a neutral position to prevent accidents while adjusting spindles, drills, or work. The gears in the box within the column run in a bath of oil, and the head is equipped with an individual oil reservoir and pump. The head can be furnished in different sizes, either round or rectangular, and spindles of various sizes may be provided.

WESTINGHOUSE AUTOMATIC ARC WELDER

A machine that automatically feeds welding wire used in metallic electrode welding, to the work at any speed, up to 3 feet per minute, necessary to maintain a constant arc length and a constant arc voltage, is one of the latest developments of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. This "Auto-Arc" machine strikes the arc automatically and, if necessary, will exert a pull of approximately 200 pounds in order to prevent fusing the electrode wire to the work. The device relieves the operator of the exacting hand labor of maintaining the arc and feeding the welding wire. The claim is made that it is possible to secure a better weld and to deposit metal much faster with this machine than by hand welding.

The arc can be maintained at an average value of from 15 to 20 volts, and will remain almost constant at any voltage. The 1/4-horsepower feed motor and the electromagnets used do not derive power from the arc circuit, and are therefore selected large enough to feed any size of wire up to 3/8 inch. This equipment can be used to advantage in welding long continuous seams, in production operations, and in some repair operations, such as building up worn locomotive cross-heads, cross-head guides, and valve guides. It may also be applied to building up worn wheel flanges of yard locomotives and street railway cars.

Fig. 2 shows the application of the "Auto-Arc" to a machine that will hold pipe, tank drums, etc., up to 8 feet long and from 10 to 40 inches in diameter. The section of pipe or tank drum that is to be welded is put in place between two parts of a clamping device. The lower half of the clamping device contains air cylinders and a copper backing-up strip. After the material has been so placed that full penetration can be obtained when the "Auto-Arc" passes across it, the operator throws over the handle located at the left-hand end of the extended arm. By this movement of the handle, air is released to raise the cylinders and press the copper backing-up strip against the pipe, thus holding the latter firmly in place.

The "Auto-Arc" is mounted on a traveling carriage having four grooved wheels which move along a track on the ex-

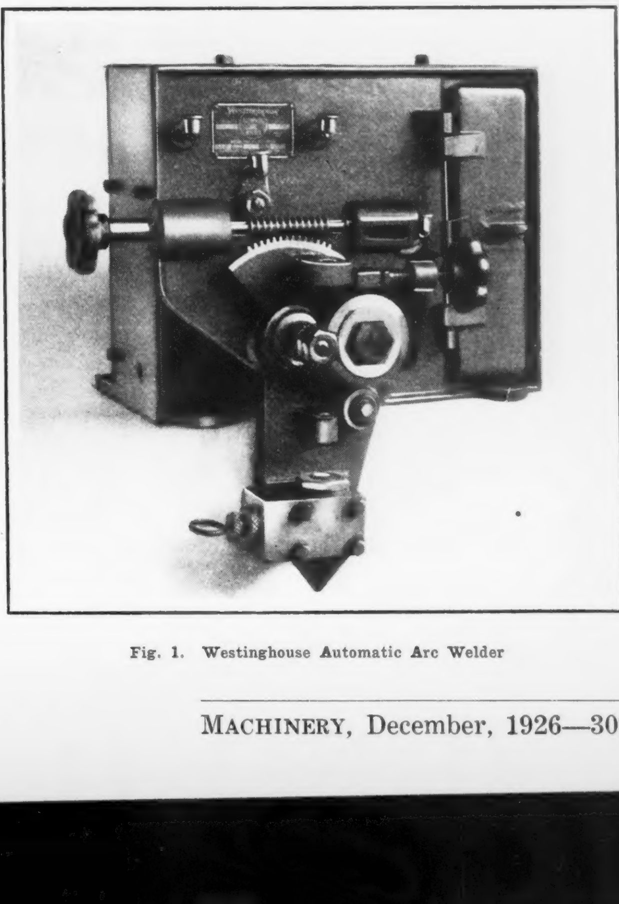


Fig. 1. Westinghouse Automatic Arc Welder

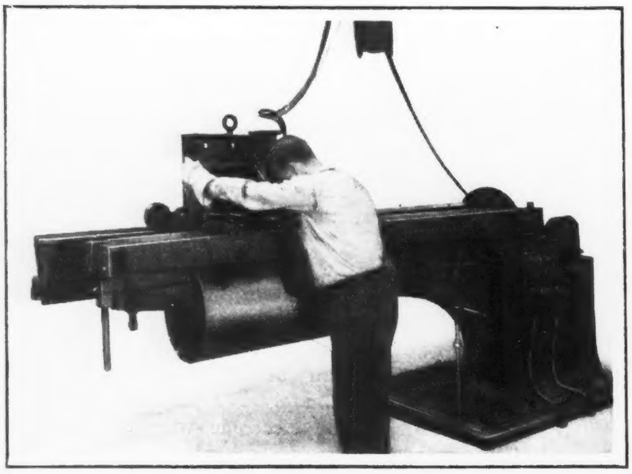


Fig. 2. Application of the "Auto-Arc" Welder

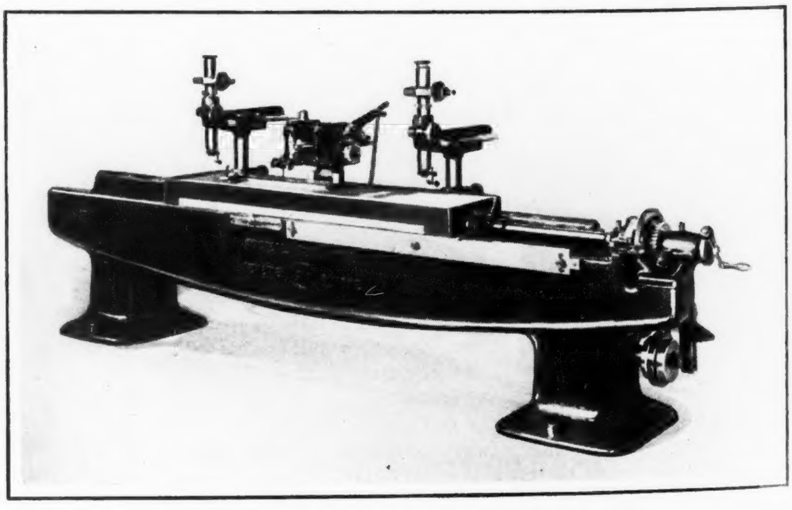
tended arm of the machine. A 3/4-horsepower motor propels the "Auto-Arc" along this track. The motion can be reversed at any point, and any irregularities in the seam are cared for by means of a handwheel which the operator regulates so as to keep the welding wire directly on the seam. Tank drums from No. 16 gage up to 3/8 inch in thickness can be welded at speeds of from 14 to 25 inches per minute.

SOCIETE GENEVOISE LINEAR DIVIDING MACHINE

Two models of precision linear dividing machines which have recently been improved by the Société Genevoise d'Instruments de Physique, Geneva, Switzerland, are being placed on the American market by the R. Y. Ferner Co., Investment Bldg., Washington, D. C. Machine No. 0015 is entirely hand-operated, while machine No. 0016 is fully automatic, being driven by 1/4-horsepower motor. The motor-driven machine is shown in the accompanying illustration. Both machines have a capacity for graduating linear scales up to 20 inches in length, and can be used for ruling metal, wood, celluloid, or glass.

The bed and lead-screw of the machines are subjected to special heat-treatments. The thread of the lead-screw has a profile angle of 30 degrees, which offers a large bearing surface and tends to lessen wear. The screw, without considering the compensating templet, is accurate to within 0.010 and 0.015 millimeter (0.0004 and 0.0006 inch), and with the compensating templet the accuracy of the machine is increased to within 0.005 millimeter (0.0002 inch). The compensating templet is located on the front of the machine, and is similar in principle to the templets used on other Société Genevoise linear dividing machines, lathes, jig boring machines, and thread grinding machines. The total periodic errors of the screw are less than 0.00008 inch.

The pattern of the bed has been entirely changed, and the micrometer head is placed at the right-hand end of the machine instead of at the left. In the new position, it is more convenient, especially for hand operation. There is a new type of tracing tool which is easily adjusted and more substantial than the tool previously furnished. With this new tool, it is possible to rule from 10 to 30 lines per minute on the automatic machine. The maximum height of the tool above the table has been increased to 3 inches, and light lines can now be ruled as well as heavy, the various widths being from 0.002 to 0.006 inch with a steel cutting tool. Lines up to 1 inch long can be ruled. A diamond tool can be supplied for producing lines as fine as 0.0001 inch in width.



Societe Genevoise Motor-driven Linear Dividing Machine

Tracelet disks with 8, 10, 12, and 16 notches permit the graduation of scales with variations in the length of line, on either the binary, decimal, or duodecimal system. The pitch of the lead-screw is 1/20 inch (or 1 millimeter in a metric machine), and ratchet wheels having 200 and 160 teeth provide for ruling as many as 4000 lines per inch, or making up verniers of practically any unit for the regular rulings that are obtainable.

Two micrometer microscopes are mounted on adjustable supports, which can be placed at any point along the bed. These serve to check work that has already been done on the machine against the screw of the machine or in comparison with another scale. They are also of use in cases where jobs longer than the capacity of the machine necessitate the resetting of work after it has been partly graduated. The machine requires a bench space of 60 by 16 inches, and it is 22 inches high. The weight of the hand-operated machine is approximately 250 pounds, and of the motor-driven machine, 330 pounds.

VIKING STOP-COUNTER

Automatic stopping of a machine after a rotating member has made any predetermined number of revolutions from 1 to 9750 can be conveniently accomplished through the application of a stop-counter recently devised and patented by the Viking Tool & Machine Co., Inc., 745-59 Sixty-fifth St., Brooklyn, N. Y. By the use of this counter, a machine can be automatically stopped after any desired production has been obtained.

The counter is particularly applicable to various types of coil-winding machines, where a predetermined number of turns of wire is required, and to wire measuring machines, power presses, and screw machines. Four styles of counters are made, the electrical type being illustrated in Fig. 1. With this device, a bell is rung an instant before the machine is stopped, and the stopping is accomplished by the disengagement of an electric switch.

In another style of counter, a clutch is operated mechanically to stop the machine. A third style has a bell or other signal which merely warns the operator that the machine has made the desired number of strokes or revolutions. The fourth style is a plain counter by means of which the number of revolutions or strokes made by a machine can be readily determined through observation of the graduations. This style ordinarily counts up to 9999, but by stepping up the gearing, the device can be arranged to count up to 99,999.

The shaft to which worm *A* of the counter is keyed is driven by some member of the machine, such as the feed-wheel shaft or crankshaft. Worm *A* drives two wheels *B* and *C*, Fig. 2, which are assembled next to each other on stud *D*, Fig. 1, wheel *B* being in front. Wheel *B* has 100 teeth and wheel *C* 99 teeth, so that with each 100 revolutions of worm *A*, wheel *C* gains 1 tooth on wheel *B*.

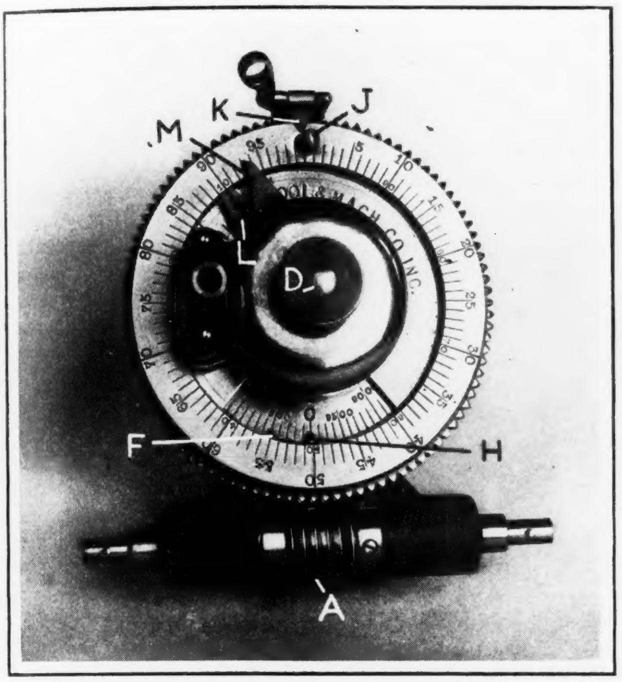


Fig. 1. Viking Counter which stops a Machine automatically when Any Desired Period of Operation has ended

Machined in the front side of wheel *C* there is a groove around which ring *E*, Fig. 2, may be adjusted to carry pointer *F* to any of the graduations on the wheel. Diametrically opposite this pointer, a slot *G* has been milled in the ring. A pointer *H* on wheel *B* is diametrically opposite pin *J*, Fig. 1. This pin is attached to a flat spring fastened to the back of wheel *B* as may be seen in Fig. 2. The graduations on wheel *C* represent even hundreds of revolutions of worm *A*, while the front of wheel *B* is graduated to record any number of revolutions of the worm from 0 to 100. It will be apparent from Fig. 1 that an opening in wheel *B* permits a portion of the graduations on wheel *C* to be observed.

In setting up the device for stopping a machine after a feed wheel has made, say, 510 revolutions, wheel *C* and ring *E* are adjusted relative to each other, to bring pointer *F* in line with the 500 graduation on the wheel. The screw of pointer *F* is next tightened to lock the adjusting ring to the wheel. Then both wheels are assembled on the device, with the zero graduation on the front of wheel *B* in line with the stationary pointer *K* (which is attached to the housing of the device) and with the zero graduation on wheel *C* coinciding with pointer *H*. Pointer *L* of the electrical unit is then positioned opposite the tenth graduation of wheel *B*, by simply swiveling the electrical unit. The setting will then be as shown in Fig. 1.

As worm *A* is now driven by the machine being timed, the two wheels revolve counterclockwise, wheel *C* creeping up on wheel *B* a distance of 1 tooth for every 100 revolutions of the worm. Thus, at the end of 500 revolutions of the worm, pointer *F* will be directly below pointer *H*. At the moment of coincidence of these two pointers, the front bent-down edge of the flat spring on the back of wheel *B* snaps into slot *G* and draws pin *J* into the hole in wheel *B*.

Prior to this time, a slot in pin *J* has permitted the pin to clear the bell-ringing levers *M*, but now the slotted portion of the pin has been withdrawn into the wheel, and as the pin is carried around with the wheels, it strikes levers *M* to ring the bell. This usually occurs about two revolutions before the worm has made the desired number of revolutions. As the zero graduation of wheel *B* coincides with pointer *L*, a switch is thrown to stop the motor which drives the machine. The electrical unit remains stationary during an operation.

At the end of an operation, it is a matter of but a few seconds to return the wheels into zero positions for the next operation. This is effected by operating a lever at the back of the device, which raises the two wheels out of engagement with the worm. Both wheels are approximately 4 inches in diameter. In addition to the applications previously mentioned, this device may be used for checking the accuracy of other types of counters.

AMERICAN BLOWER AIR FILTER

A new air filter of dry-plate design with hair-like tentacles for arresting and retaining dust and dirt is being introduced on the market by the American Blower Co., 6004 Russell St., Detroit, Mich. In this filter, the dust-laden air is divided into a series of small jets, which strike the flat filament-coated surface of the plates. The dust and soot are projected against the filament, seized and retained, while the air rebounds from this surface and flows through to the next plate. It is carried through ten successive dust removal operations of this type.

As dust builds up on the flat plate surfaces, each preceding layer acts as a retentive member, the dust itself being the principal dust-arresting and retaining factor for the ensuing particles of dust and dirt. The advantages claimed for this type of air filter are that it is impossible to clog it, that it does not require oil or other adhesives that must be changed from time to time, and that it has a constant efficiency.

BROWN & SHARPE MOTOR-DRIVEN UNIVERSAL GRINDING MACHINES

The Nos. 2, 3, and 4 universal grinding machines built by the Brown & Sharpe Mfg. Co., Providence, R. I., are now arranged with completely self-contained motor drives, for installation where individual drives are desired and where overhead drives are prohibited. No more floor space is required than when the machines are driven by belt from a lineshaft. Power for driving the headstock, wheel-spindle, and table feed is supplied on each machine by three motors. These motors are controlled by a single push-button switch located at the front of the machine near the controls, within convenient reach of the operator. "Burning out" of the motors through overloading is prevented by protective plugs in a magnetic switch control box mounted on the base casting at the rear. Any motor not needed may be "cut out" by removing one of the protective plugs from this switch.

The method of taking the drive from the motors may be readily noted by referring to the illustration. It will be

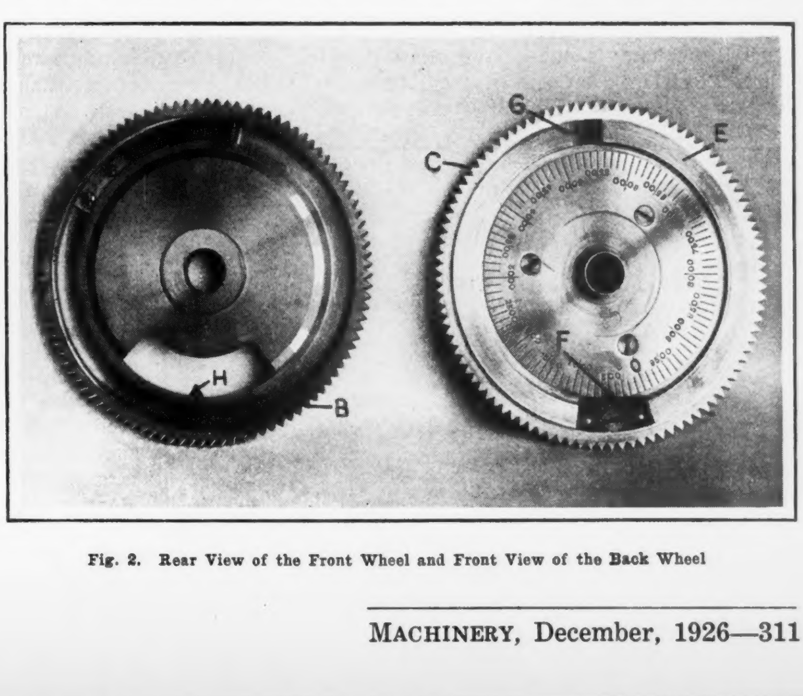
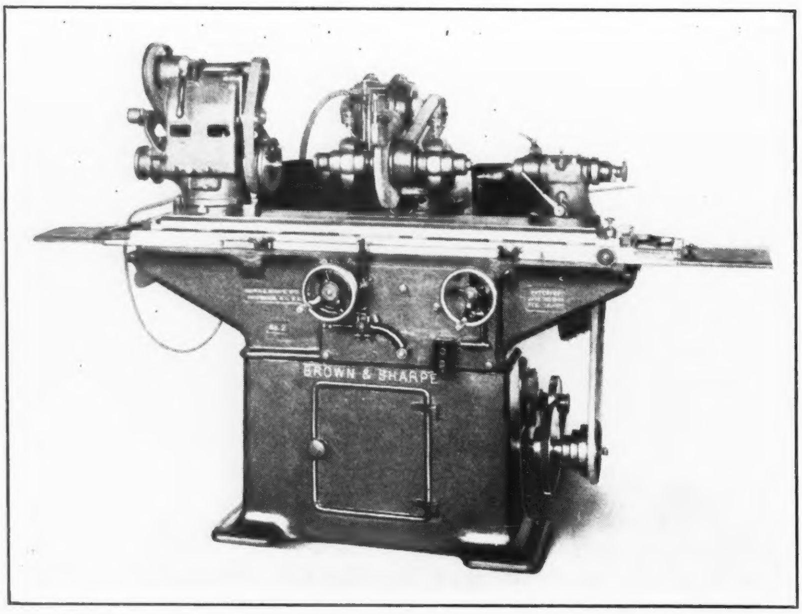


Fig. 2. Rear View of the Front Wheel and Front View of the Back Wheel



Brown & Sharpe Universal Grinding Machine with Complete Motor Drive

the finger is removed from the trigger. An improved method of attaching the cable is used, which allows for taking up or renewing the cable quickly. Hardened alloy steel gears make the tool adapted for drilling in metal or wood, either on continuous production or on intermittent work.

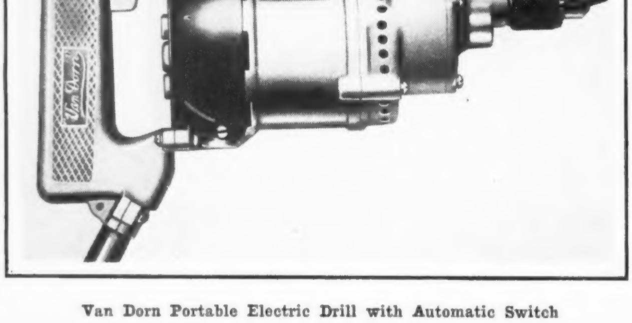
The motor is of the universal type for operation on alternating or direct current. It runs at a no-load speed of 1500 revolutions per minute and a full-load speed of 900 revolutions per minute. The drilling capacity in steel is 5/16 inch. The over-all length of the drill is 12 1/2 inches, and the weight, 7 pounds.

seen that the motors are amply protected, and yet readily accessible and in advantageous positions for the delivery of power to the operating parts of the machine. The work-driving motor is mounted on the headstock, which is compactly designed and has provision for driving the work on either live or dead centers. The wheel-spindle driving motor is mounted on the wheel-stand, and the latter is bolted to the wheel-stand platen. The drive is direct from the motor belt to the spindle pulley, except when the internal grinding attachment is used. In this case, the spindle is replaced by a countershaft through which the drive is delivered to the attachment.

The motor that provides power for the automatic table travel and cross-feed is located at the rear. This motor is also employed to drive a pump which provides an abundant supply of water for wet grinding. Several types of constant-speed motors and various styles of control equipment suitable for use with direct or alternating current can be furnished to meet the requirements of different installations.

VAN DORN PORTABLE ELECTRIC DRILL

A 5/16-inch portable electric drill equipped with ball bearings throughout is one of the latest products of the Van Dorn Electric Tool Co., Cleveland, Ohio. With the switch that is provided, the current is shut off automatically when



Van Dorn Portable Electric Drill with Automatic Switch

WARNER & SWASEY UNIVERSAL TURRET LATHE

A new No. 4 universal turret lathe is being introduced to the trade by the Warner & Swasey Co., Cleveland, Ohio. This machine has a bar capacity of 1 1/2 inches, and the maximum swing over the ways is 16 inches. Three types of head may be provided, either a six-speed all-geared head; a six-speed cone head; or a twelve-speed all-geared head. More than twice as much power is delivered

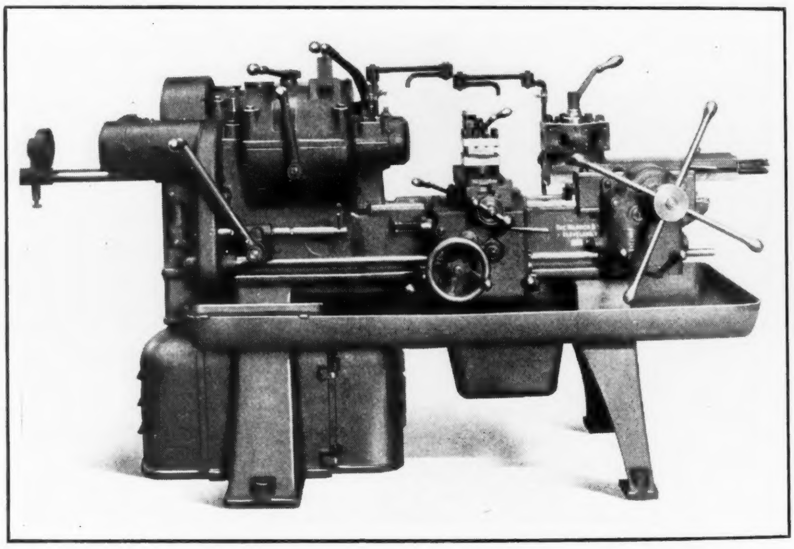


Fig. 1. Warner & Swasey Improved Universal Turret Lathe with All-geared Head

to the spindle through the six-speed all-geared head as through the cone head. On this all-geared head, any one of six forward spindle speeds, ranging from 45 to 423 revolutions per minute, is instantly available by moving conveniently located levers. Two reverse speeds are obtainable. The gears run in oil and the shafts in Timken roller bearings. Babbitt-lined bearings are provided for the spindle itself. This all-geared head is well suited to individual motor drive. A pedestal leg is provided for the machine at the headstock end of the bed, in which the motor can be placed. Both ends of the motor cabinet are hinged to make the motor easily accessible. There is also provision for mounting the motor on a vertical plate fastened to the head end of the machine.

The cone head employs a three-step cone pulley and back-gearing. The back-shaft is fixed in position, with the gears always in engagement. In former designs of Warner & Swasey hand screw machines, an eccentric movement was provided to release the back-shaft gears from contact with the spindle gears. This movement has been found unnecessary, and hence the entire construction is more rigid. The front spindle bearing is 3 inches in diameter and 4 1/2 inches long, while the rear bearing is 2 1/2 inches in diameter and 3 3/4 inches long. By running both pulley countershafts forward at different speeds, the number of spindle speeds obtain-

able with this type of head is increased to twelve. However, no reverse movement is provided for the spindle.

The twelve-speed all-geared head is of the same design as the head provided on the No. 4 machine described in January, 1925, MACHINERY. The spindle speeds available range from 30 to 760 revolutions per minute. This type of head is more powerful than the six-speed type. The speed changes are obtained through sliding gears which run in oil. Adjustments of the friction clutch are easily made. This head is recommended for work requiring a large variety of spindle speeds.

Operation of the automatic chuck and bar feed is accomplished by means of the long lever at the front of the head. Through this lever, the work may be gripped or released instantly. The lever actuates a pivoted yoke equipped with rollers which engage a stepped wedge on the spindle, as illustrated in Fig. 3. The mechanism constitutes an improvement which substantially reduces the effort formerly required to operate the chuck. The collet is automatically adjusted for slight variations in the diameter of work.

The universal cross-slide carriage is retained in the new design of this machine. It provides a unit having power longitudinal feeds either to the left or right, and power cross-feeds in either direction. There are four cutter positions on the square turret and one on the rear toolpost. Four independent adjustable stops carried on a stop roll are employed to throw out the longitudinal feed. All feeds can be selected from the carriage apron, and they can be reversed.

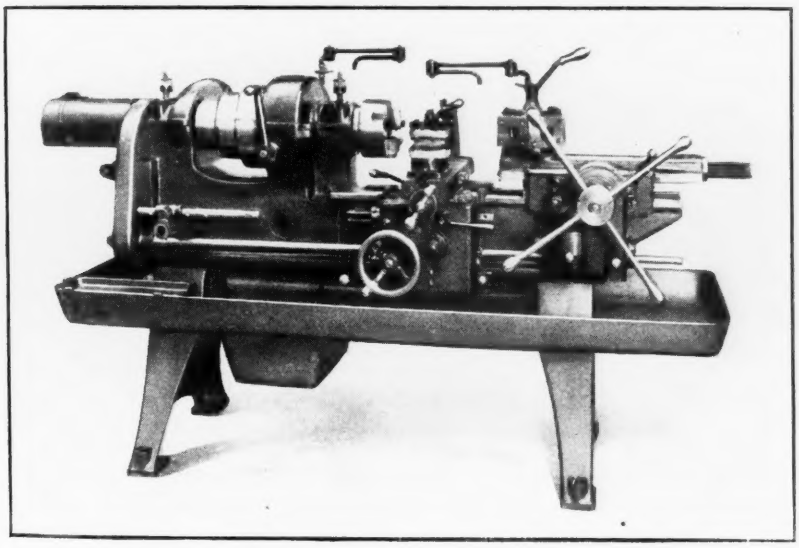


Fig. 2. Cone Head Universal Turret Lathe of Improved Design

In the direction of feed, the cross-slide carriage is independent of the turret. A large graduated dial having adjustable indicators is fitted to the cross-slide for accurately gaging the depth of cut. The square turret can be quickly indexed without being lifted from its seat. Alignment and adjustment of the square turret are obtainable by means of hardened and ground tapered wearing surfaces.

The turret-slide and saddle unit is of the standard Warner & Swasey type. A supplementary taper base and taper gibs provide for vertical and horizontal adjustments, to insure alignment of the spindle and tools. The turret stud is tapered so as to permit adjustment for wear. Six power feeds are obtainable through a gear-box mounted at the front of the saddle. There are independent adjustable stops for each turret face, and these may be set to throw out the power feed at any desired point. These feeds are independent of the cross-slide carriage feeds.

This universal turret lathe is offered either with or without standard bar or chucking equipment. A taper attachment may be furnished, by means of which tapers up to 3 inches per foot, in lengths of 6 inches, may be turned. The operation of the square and hexagon turrets is not affected by the installation of the taper attachment. With the screw-chasing attachment, threads of from 4 to 32 per inch can be

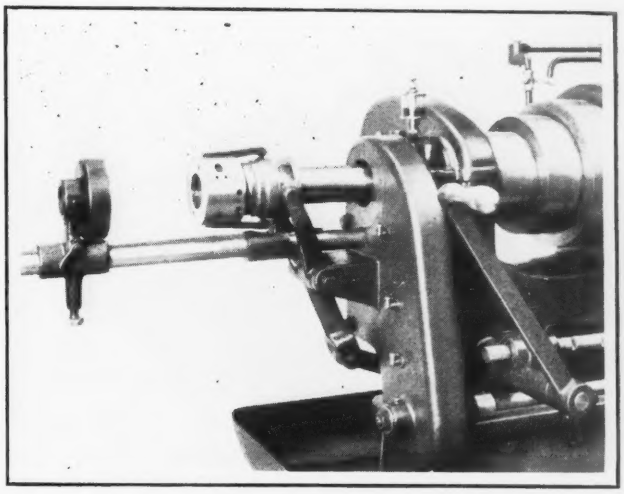


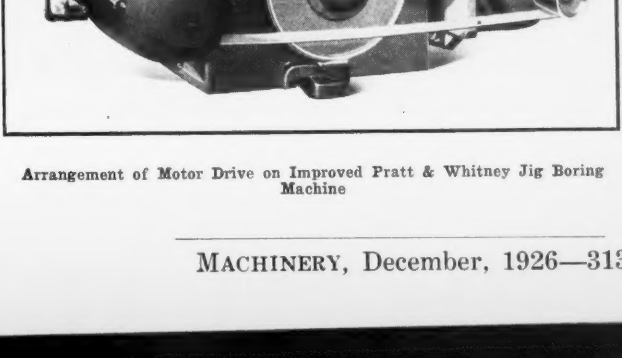
Fig. 3. Automatic Chuck and Bar Feed Mechanism

cut. A micrometer screw on the cross-slide provides a fine adjustment for the depth of cut. This screw-chasing attachment is of an entirely new design.

PRATT & WHITNEY JIG BORING MACHINE

Improvements that facilitate the operation have recently been made in the jig boring machine built by the Pratt & Whitney Co., Hartford, Conn., which was described in April, 1925, MACHINERY. The drive to the spindle is still by means of a belt running from a large pulley at the rear of the bed, up over idler pulleys which give it a quarter turn, to a large pulley on the spindle. However, the idler pulleys are now made adjustable, so that the tension in the belt can be regulated quickly at any time. The brackets of these idler pulleys are fastened to the rear of the column head by bolts which pass through slots in such a way that the pulleys can be adjusted up and down as required. To provide for this adjustment, the pulley on the spindle has been widened.

The motor drive has been rearranged to make the machine more compact. Whereas the motor was formerly mounted on a bracket at the rear left-hand side of the bed, it is now hung on a swinging platform in approximately the same position, and the motor is now on its side, as may be seen from the illustration. This construction permits the motor belt tension to be adjusted by means of a screw adjustment on the motor platform. The main drive to the machine was formerly through a pair of tight and loose pulleys. These pulleys have been replaced by a larger friction clutch pulley, which does away with the necessity

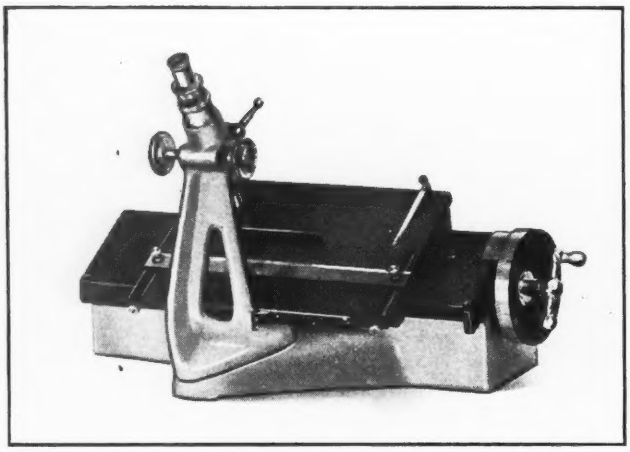


Arrangement of Motor Drive on Improved Pratt & Whitney Jig Boring Machine

of shifting the belt back and forth and eliminates the long motor pulley. This new friction clutch drive is enclosed by a cast-iron guard, which can be easily shifted from the vertical to the horizontal position to adapt the machine to either a countershaft or a motor drive. A cast-iron guard is also furnished to enclose the friction clutch on the spindle pulley. This guard not only keeps out dirt, but improves the appearance of the machine. The longitudinal and transverse table movements are effected by fast- and slow-motion handwheels.

HILGER MICROSCOPE-MICROMETER MEASURING DEVICES

Two microscope-micrometer measuring devices of the type here illustrated have recently been developed by Adam Hilger, Ltd., 24 Rochester Place, Camden Road, London, N.W. 1, England. The devices are similar, with the exception that the drum on the model L13, by means of which readings are made, is divided into 100 parts and, through a vernier, gives readings to 1 micron (1/1000 of a millimeter), whereas the drum of the model L18 is divided into 1000 parts, and a double vernier gives readings to 0.1 micron.



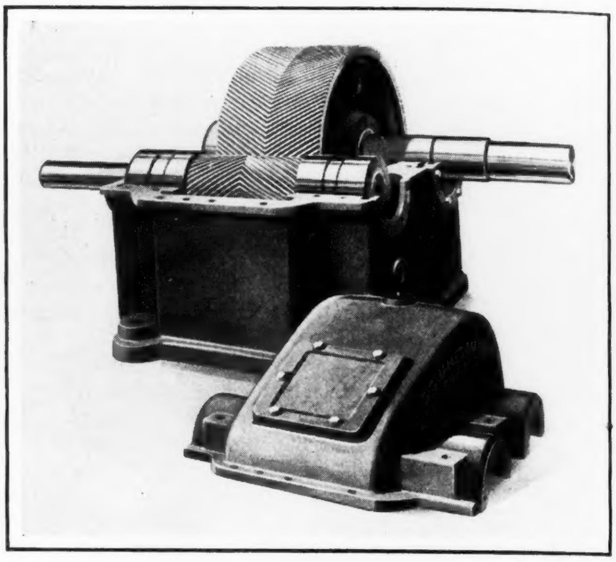
Hilger Microscope-Micrometer Type of Measuring Device

Each model has a table travel of 150 millimeters (approximately 6 inches).

The microscope is fixed to the bed, and the table or carriage is adjustable longitudinally by means of a micrometer screw. The carriage may be released from the nut that engages with the micrometer screw, to permit rapid lining up of the specimen to be measured in the field of the microscope. End thrust of the screw is taken by a sapphire block, set true by reference to interference bands formed between the hardened and polished end of the screw and the flat surface of the sapphire block. The screw has a pitch of 1 millimeter and an outside diameter of 16 1/4 millimeters. Focussing of the microscope is accomplished through a rack-and-pinion mechanism.

JAMES HERRINGBONE-GEAR SPEED REDUCERS

Herringbone gears with continuous teeth are employed in a new line of speed reducers recently brought out by the D. O. James Mfg. Co., 1120 W. Monroe St., Chicago, Ill. Each individual tooth is brought to an apex and has the shape of a completed vee, the tooth being in no way broken or the apex rounded to provide tool clearance. The teeth are cut involute with a 20-degree pressure angle and a 30-degree helix angle. The helix angle of 30 degrees is said to result in the neutralization of end thrusts. Overlapping of the teeth makes for continuous, smooth, and noiseless operation, there being no shocks when the load is passed from one tooth to the next. Two teeth are always in mesh in the plane of the axis. These herringbone-gear speed reducers are built in reduction ratios of from 2:1 to 150:1, for carrying loads



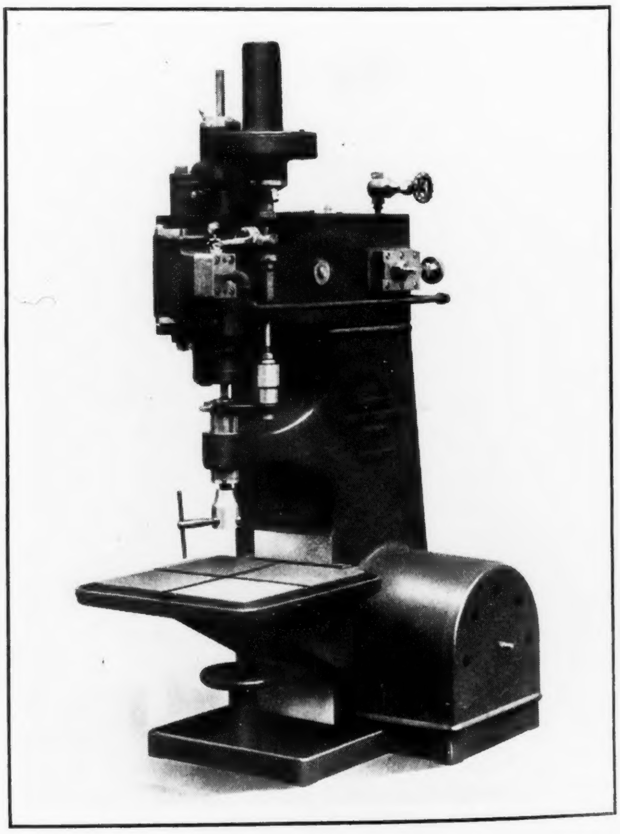
James Continuous-tooth Herringbone-gear Speed Reducer

from 2 to 200 horsepower. They are of rugged construction for driving heavy equipment, such as is used in steel, lumber, paper, sugar, and chemical mills.

"HY-SPEED" PNEUMATIC REVERSING TAPPING MACHINE

A bench type "Hy-Speed" tapping machine in which reversal of the tap is accomplished pneumatically has recently been developed by W. H. Simmons & Co., 208-12 Lawrence St., Cincinnati, Ohio. One of the features of the compressed-air mechanism is that adjustments for wear are made automatically. The machine has a capacity for driving taps up to 3/16 inch in steel and up to 1/4 inch in brass and other soft metals. It has been designed to meet high production requirements.

Spindle speeds as high as 3000 revolutions per minute can be employed. The reversing is accomplished accurately in



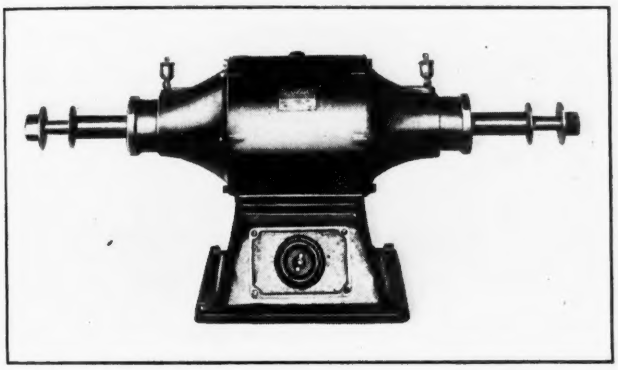
"Hy-Speed" Tapping Machine with Pneumatic Reversing Mechanism

tapping to a specified depth, when the reversing nuts have been adjusted to suit. A patented lead and nut attachment gives the effect of chasing threads and eliminates the need of a fixture for holding work down while the tapping operation is being performed. A fixture is required only to prevent the work from turning.

The maximum stroke of the spindle is 1 1/2 inches, and the minimum stroke, 1/2 inch. Ball bearings are used throughout. The machine is equipped with a belt tightener and positive-drive chuck. There is a safety device for the protection of taps, should the operator fail to locate the hole to be tapped under the machine spindle. The knee type of table may be removed to permit substituting a special fixture. The machine is driven by a 1/2-horsepower motor located in the base. The weight of the machine is approximately 415 pounds.

MOTOR-DRIVEN BENCH BUFFER

Three sizes of the motor-driven bench buffing stand here illustrated are now manufactured by the Standard Electrical Tool Co., 1938-46 W. 8th St., Cincinnati, Ohio. The three sizes have a rating of 1/2, 1, and 2 horsepower, respectively.



Motor-driven Buffer built by the Standard Electrical Tool Co.

The buffer is equipped with ball bearings, which are adequately protected from dust. In addition to the bench style, the buffer is also made in a pedestal type.

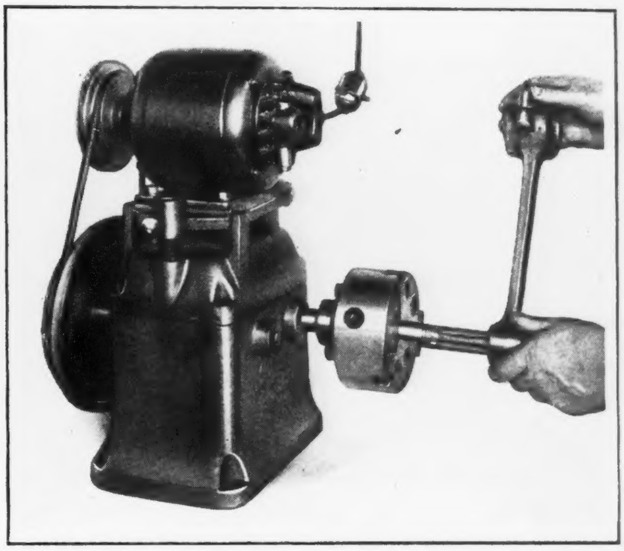
STARRETT FLEXIBLE STEEL RULE WITH CLIP

On a flexible 6-inch steel rule made by the L. S. Starrett Co., Athol, Mass., for machinists, inspectors, etc., there is a clip that holds the rule firmly to a vest pocket or other part of a workman's clothing. The harder the rule is pulled, the more firmly the clip holds, and it is released only when a pawl is pressed down. The clip is permanently soldered to the rule at the 4-inch mark, the average pocket depth being taken into consideration.

ALTO MOTOR-DRIVEN REAMING MACHINE

Two speeds of 30 and 60 revolutions per minute are available on a motor-driven reaming machine now built by the Alto Mfg. Co., 1647-51 Wolfram St., Chicago, Ill. This machine is intended for driving reamers from 1/8 to 1 1/2 inches in diameter, and the two speeds enable any reamer to be driven at a speed suitable for its size.

Another feature which promotes safety is a combination belt and gear drive; with this drive, the operator can let the belt slip in the event that a reamer becomes stuck in the work. A 1/4-horsepower motor drives the machine, the reamers being held firmly so as to eliminate any tendency to "bite." The chuck is of the geared scroll type. A bench space of 9 by 11 inches is occupied by this machine and the height of the machine is 18 inches. The way the work is held for an operation will be evident from the illustration.

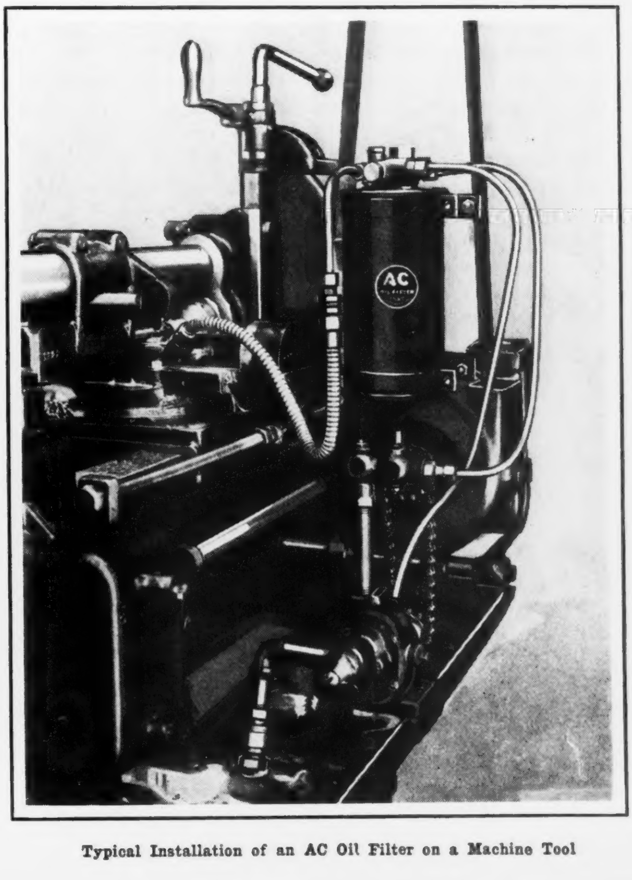


Alto Motor-driven Reaming Machine

AC INDUSTRIAL OIL FILTER

An oil filter applicable to machines is now manufactured by the AC Spark Plug Co., Flint, Mich., for removing grit and dirt from lubricating oils and cutting compounds or coolants. The filter has been installed on automatics, gear cutting and hobbing machines, centerless grinders, thread-cutting and thread-rolling machines, swaging machines, and burnishing machines. A typical installation is here illustrated. The filtering capacity of an installation is made to suit requirements by providing one filter or banks of several filters connected in multiple.

Dirty oil or cutting compound enters the filter under pressure, and is forced into tubular passages in a cloth bag. It filters through this bag, leaving the dirt on the inside. The clean oil or compound then passes through a cylindrical screen, which is used to support the cloth bag, and enters a tank. It is forced from the tank under pressure. When the filtering unit becomes clogged, it can be conveniently replaced.



Typical Installation of an AC Oil Filter on a Machine Tool

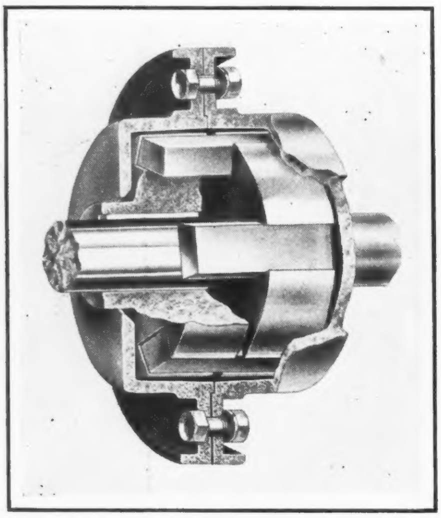


Fig. 1. Nicholson All-metal Flexible Coupling

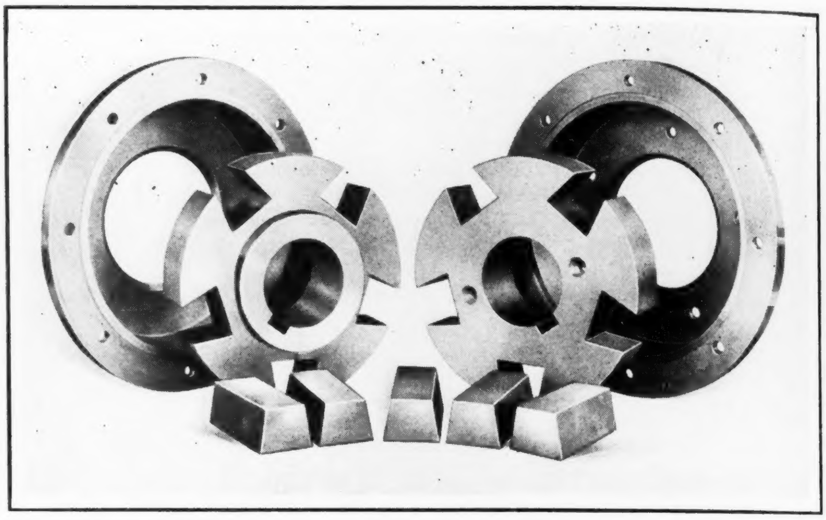


Fig. 2. Disassembled View of Nicholson Flexible Coupling

NICHOLSON FLEXIBLE COUPLING

In an all-metal flexible coupling now being placed on the market by W. H. Nicholson & Co., 114 Oregon St., Wilkes-Barre, Pa., all forms of shaft misalignment are compensated for by means of loose-fitting floating keys. A liberal amount of lateral float is permitted, as well. The keys have beveled sides and fit dovetail slots in two cast-steel hubs which are mounted on the adjoining ends of the shafts to be connected. In the small sizes of the coupling, three floating keys are provided, and in the large sizes, five keys, as shown in the illustrations.

When the coupling is in motion, centrifugal force throws the floating keys radially outward in the dovetail slots and causes the keys to drive quietly and smoothly. When the torsional load is sufficient to overcome the centrifugal force of the floating keys, the keys recede toward the bottom of the slots. The interior of the coupling is filled with oil in order to maintain a film of oil between the surfaces of the keys and slots and thus allow a free lateral float of the coupling hubs. Wear is kept to a minimum by the oil, but any wear that might occur on the sides of the keys after years of service, would be taken care of, as the keys are forced outward by the centrifugal force.

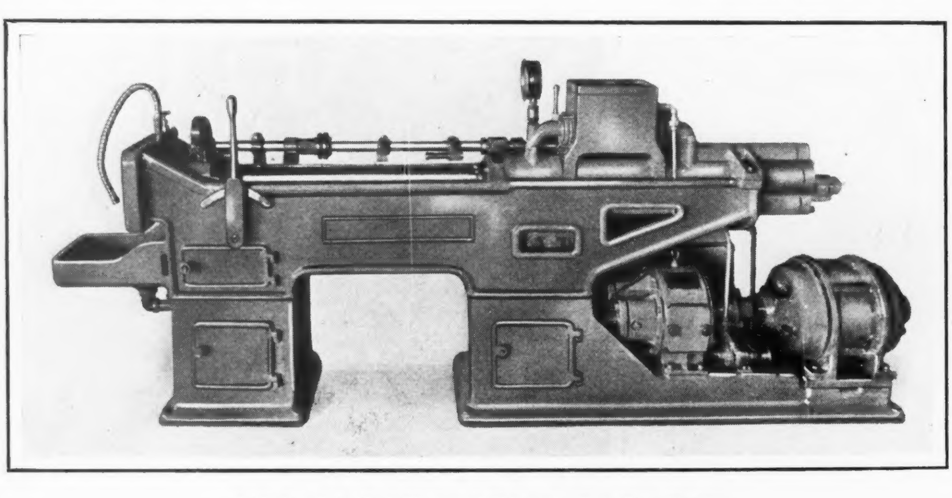
Keys can be quickly made up in any shop for replacement purposes, should the occasion require. The strength of the keys is much in excess of the shaft strength, and so any given size of coupling will withstand a greater load than the shaft itself. The working parts of the coupling are enclosed in a two-piece cast-steel casing. A gasket is placed between the flanges of the casing to insure a tight fit and make it impossible for oil to fly out. The floating keys and the hubs are of steel. This coupling is made for all sizes of shafts and all sorts of applications.

J. N. LAPOINTE HYDRAULIC BROACHING MACHINE

Two new machines—Nos. 2S and 2L—have recently been added to the line of hydraulic broaching machines built by the J. N. Lapointe Co., New London, Conn. These machines are believed to be the smallest of the horizontal hydraulic type on the market. The draw-rod stroke of the No. 2S machine is 30 inches, and that of the 2L machine, 48 inches. Broaches up to 34 inches long over all may be mounted in the smaller machine, and up to 52 inches long, in the larger machine. With the exception of their dimensions and the size of the motor, pump, etc., both machines are identical in design to the No. 3L machine described in May MACHINERY.

An infinite range of cutting speeds up to 33 feet per minute is provided, and the return speed may be varied from 10 to 180 feet per minute. Pressure is supplied by a Hele-Shaw variable-delivery multi-plunger pump. With a pressure in the cylinder of 1000 pounds per square inch (the maximum recommended), for which a relief valve in the pump is set, a pull of 15,000 pounds is exerted on the draw-rod. The cylinder is cast of hydraulic iron, and has an internal diameter of 5 inches. The pump may be driven direct by an electric motor or from a countershaft. A 5-horsepower motor running at 900 revolutions per minute is recommended. One of the particular features of the machine is that a low-pressure relief valve is arranged to open automatically in the event that the ram meets undue resistance on a return stroke. This provision eliminates the breakage of broaches often caused by the tool being backed against the inside of the faceplate.

An automatic stop is furnished for controlling the length of stroke. Complete control is also provided through a hand-lever, which permits starting or stopping the ram at any point on either the cutting or return stroke. Coolant is supplied to the broach by a Brown & Sharpe geared pump, both as the broach enters and as it leaves the work. One of the time-saving features of the machine is a removable chip pan which is located in the front part of the bed, as shown in the illustration. While the broach is being pulled through the work, coolant washes the chips from the broach into the pan. The pan is perforated to allow the coolant to drain into the reservoir in the base. Only a few seconds are required to remove, empty, and replace the pan.



J. N. Lapointe Variable-speed Hydraulic Broaching Machine

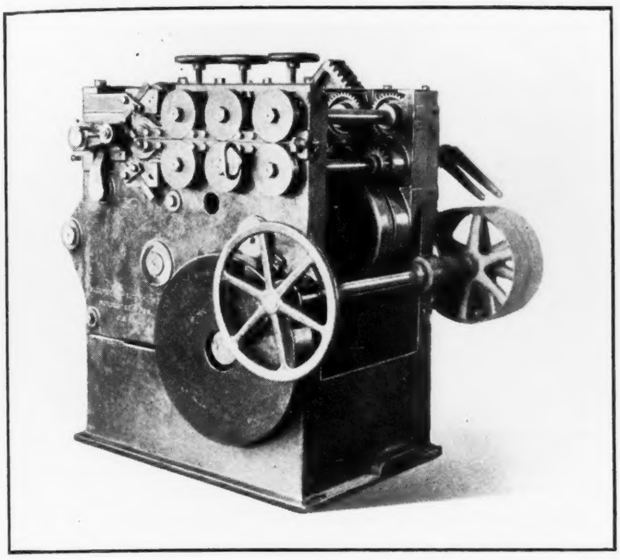


Fig. 1. Sleeper & Hartley Segment-type Universal Spring Coiler

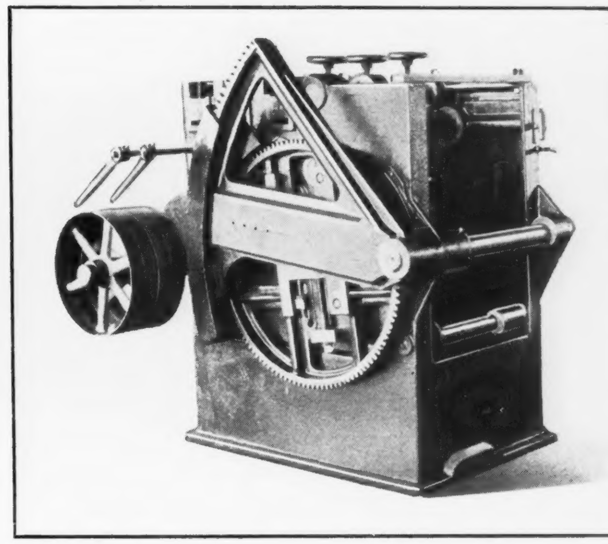


Fig. 2. Rear View of Universal Spring Coiling Machine

On the two machines, the hole in the faceplate has a diameter of 5 inches; the vertical adjustment of the draw-head above and below centers is 1 5/8 inches; and the driving pulley is 16 inches in diameter and has a 5-inch flanged face. The No. 2S machine weighs about 3500 pounds, and occupies a floor space of 8 feet 6 inches by 20 inches. The weight of the No. 2L machine is about 4200 pounds, and this machine occupies a floor space of 11 feet 6 inches by 20 inches.

BONNEY RIGHT-ANGLE WRENCHES

Wrenches having openings at right angles to the handles are now being made of chrome-vanadium steel by the Bonney Forge & Tool Works, Allentown, Pa. These wrenches are designed for use in close quarters, where it is impossible to work with a wrench having 15- or 22 1/2-degree openings. The heads of the wrenches are "pear-shaped" to make the jaw ends sharp and facilitate the use of the wrenches in close corners. These wrenches are made with all standard combinations of openings from 5/16 to 7/8 inch.

SLEEPER & HARTLEY SPRING COILING MACHINES

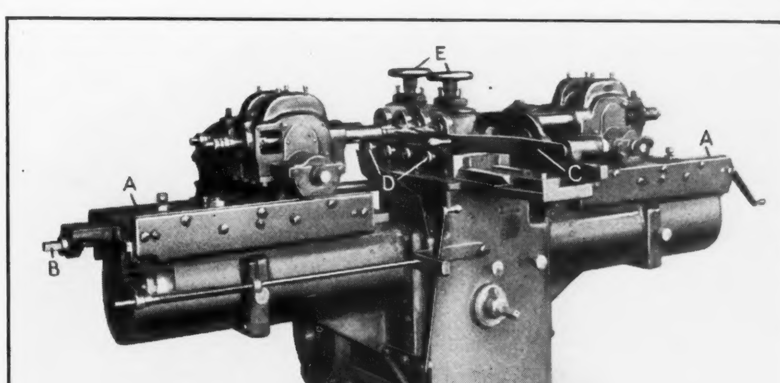
Two universal spring coiling machines—the Nos. 3 1/2 and 4 1/2—are being placed on the market by Sleeper & Hartley, Inc., 335 Chandler St., Worcester, Mass. These machines are built in crank and segment types, and can be employed for producing all sorts of springs. They will coil and cut open- or close-coiled springs, right- and left-hand springs, two-diameter springs, cone springs with any degree of taper and with a variable pitch, barrel springs with any desired crowning, springs with one or both ends tapered, etc. The No. 3 1/2 machine handles from 0.105 to 1/4 inch wire, and the No. 4 1/2 machine, from 0.162 to 3/8 inch wire. Views of the No. 3 1/2 coiler are shown in Figs. 1 and 2.

All spring forms within the capacity of the machine are obtainable by merely adjusting various working members. The adjustments necessary in changing from one spring form to another can be made in from ten to twenty minutes. Square and rectangular, as well as round wire, can be handled, and the construction of the machine eliminates the necessity of squaring the ends of the springs by heating and pressing. The weight of the No. 3 1/2 machine is about 3850 pounds, while the larger size—the No. 4 1/2 machine—weighs about 9800 pounds.

"HOLE HOG" HORIZONTAL DUPLEX MACHINE

A "Hole Hog" No. 19 horizontal duplex machine has recently been built by the Moline Tool Co., Moline, Ill., with four standard heads and a jig for drilling wrist-pin holes in automobile pistons. As may be seen from the illustration, two side members are bolted to the pedestal of this machine to form a long bed. Extending through the center of this bed is a large shaft carrying two drum cams which move slides *A* along the ways of the bed. These slides are constructed to carry standard single spiral heads, the spindles of which are laterally adjustable to take care of drill wear.

Power for driving the machine is derived from a 7 1/2-horsepower motor running at 1200 revolutions per minute, which is mounted on the rear of the base and belted to a pulley on a drive shaft that rotates in radial ball bearings. From this main drive shaft, power is transmitted through spiral gearing for rotating the spindles. Power for the feed is taken from the drive shaft and transmitted to the spindles through gearing and cams. The cams are designed to give a quick approach of the drills to the work, a slow feed, and a quick return to the starting position. The slides move in unison, but they are independently adjustable through a screw *B* with which each slide is equipped. Rollers mounted



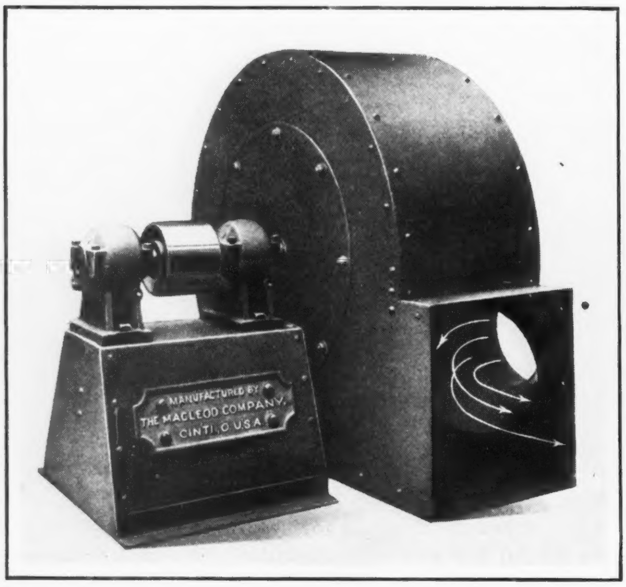
"Hole Hog" Duplex Machine arranged for simultaneously drilling Two Automobile Pistons

on the slides run in grooves in the cams, and those parts of the cams that do the heaviest work are made of hardened steel.

The jig holds four pistons at one time, and is mounted on a sliding plate that is actuated by lever *C*. Two pistons are drilled while two others are being loaded. When the spindles return to the starting position, the jig is indexed to carry the finished pistons from the drilling position and to bring the new pistons into position to be drilled. The cycle is then repeated, a cycle consuming forty-five seconds. The machine can be set to repeat the cycle without stopping or it can be arranged to stop automatically at the completion of every two pistons. The pistons are centered in the jig by means of cam clamps which are operated by knobs *D*, and they are clamped by manipulating handwheels *E*. A floor space of 8 feet 8 inches by 4 feet 8 inches is required for this machine.

MACLEOD-KEENEY EXHAUST FANS

All kinds of materials that can be conveyed by air, including tumbling-barrel, polishing, grinding, and sand-blast dust; wood shavings; sawdust; steam; smoke; and acid fumes can be handled by the "Everlasting" exhaust fans recently developed by the Macleod Co., Bogen St., Cincinnati, Ohio. The principal feature of these fans is that the material being



Macleod-Keeney Exhaust Fan for conveying a Wide Range of Materials

conveyed does not come into contact with the impeller. This prevents the fan from becoming clogged or out of balance, and results in longer life.

As indicated by the arrows in the accompanying illustration, the material to be conveyed is drawn through a projected inlet and discharged at right angles to this inlet. The impeller is protected by a deflector plate, and the creation of suction by centrifugal force is the only duty imposed on it. In passing the inlet, the air produces a high suction for conveying the material.

These exhaust fans are built almost entirely of steel. Double-row self-aligning ball bearings are provided for the impeller shaft. There is a choice of over thirty installations for a fan; for instance, a fan may be placed on the floor or reversed and bolted to overhead timbers. The discharging outlet may be adjusted to point in any direction. The fans are made in various sizes, with inlets ranging from 9 inches to 33 inches in diameter.

Gardner Disk Grinder with Vertical Spindle and Motor

GARDNER VERTICAL-SPINDLE DISK GRINDER

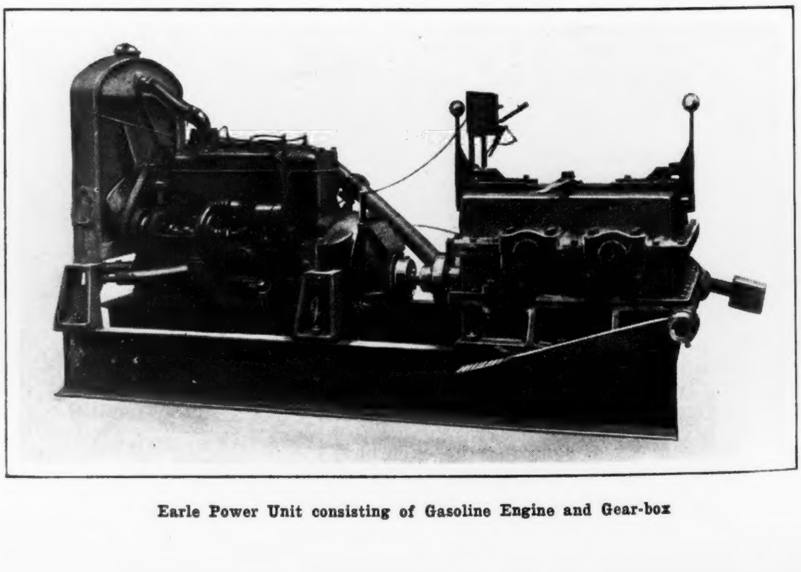
Wet or dry grinding can be performed on a No. 79 vertical-spindle disk grinder recently brought out by the Gardner Machine Co., 414 E. Gardner St., Beloit, Wis. This machine is provided with a 72-inch disk and, except for its size, is the same as the 53-inch machine illustrated in January, 1926, MACHINERY. The machine is driven by a vertical motor, which is direct-connected and eliminates all belts, pulleys, and gears in the drive. It also reduces the required floor space to a minimum. The grinding member consists of a deep corrugated G. I. A. disk.

The steel disk is reinforced by a 40-inch steel plate, 1 inch thick, and is mounted on a heavy supporting collar, fitted to the upper end of the rotor shaft which forms the driving spindle of the machine. The motor frame itself serves as the machine pedestal, the base also being the motor end plate. This frame is so constructed that air circulates through it without reaching the rotor or stator windings. Cool air is drawn up through openings in the base of the grinder by fan blades mounted on the under side of the disk, and after circulating around the motor frame, is forced out through eight holes spaced around the frame. A remote-control push-button switch may be mounted anywhere on the base.

A cast-iron guard ring is fastened to the top of the base, to which work-holders, a dressing device, etc., may be secured. The dressing device is of the horizontal-bar type, on which a sliding block, carrying the dresser cutters, is forced back and forth across the abrasive disk by hand. A patented pneumatic press is furnished for setting up the abrasive disk. The machine weighs approximately 9000 pounds.

EARLE POWER UNITS

Power units having capacities ranging from 15 to 100 horsepower are now manufactured by the Earle Gear & Ma-

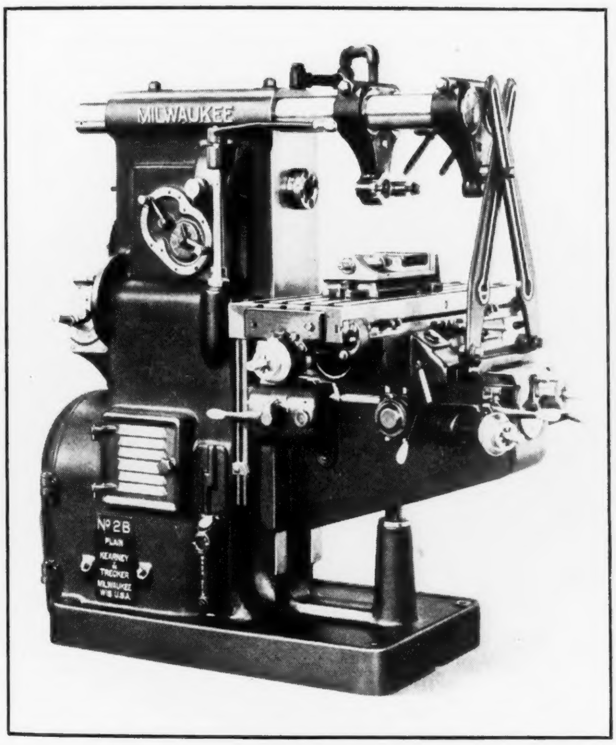


Earle Power Unit consisting of Gasoline Engine and Gear-box

chine Co., 4707-15 Stenton Ave., Philadelphia, Pa., for use in the operation of large valves, lock-gates, etc. The smallest size weighs about 2000 pounds, and the largest, 3500 pounds. Power is derived from a gasoline engine of standard make, which is equipped with such accessories as a radiator, magneto, starter, generator, storage battery, and disk clutch. There is a gear-box which provides for either one or two reversible power "take-offs" at right angles to the unit and on either side of the box, or parallel to the engine crankshaft and at the rear of the box. A brake is provided when required, to give more accurate control. All gears have cut teeth, and are made of forged alloy steel. The equipment is mounted on a structural steel frame, which makes a compact unit and results in smooth operation.

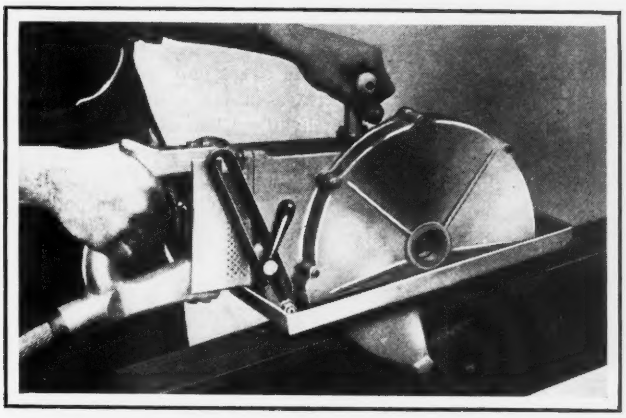
KEARNEY & TRECKER MILLING MACHINE

A new No. 2 milling machine is being placed on the market in manufacturing, plain, and universal types, by the Kearney & Trecker Corporation Milwaukee, Wis. This machine is similar in design to the larger Nos. 3 and 4 machines described, respectively, in September and June MACHINERY. The machine may be equipped with a belt or a motor-in-base drive, the same column being provided in either case. The drive is all-geared from either the motor pinion or the driving pulley shaft. The clutch is of the multiple-disk friction type.



Kearney & Trecker Milling Machine built in Manufacturing, Plain, and Universal Types

Power rapid traverse is provided in three directions on the plain and universal machines, but not on the manufacturing type, which has a power feed and a rapid traverse for the table only. Self-oiling universal joints are furnished for all feed and power rapid traverse shafts. Duplicate control levers are provided at the front and rear of the machine. Lubrication is furnished to the column, knee, and saddle from centralized points. There is an automatic low-pressure coolant system with a "cut-out" and an improved means of distribution. The lubrication and cutter-coolant pumps are readily accessible and may be quickly removed.


"Alta" Power Hand Saw

"ALTA" POWER HAND SAW

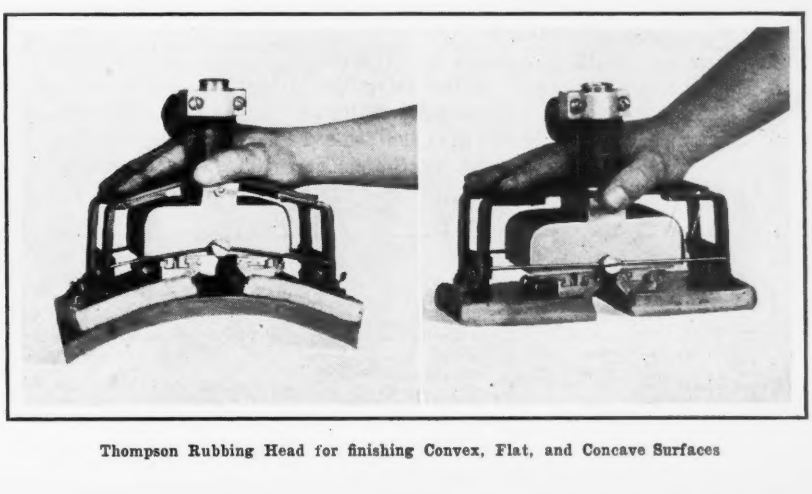
Lumber up to 3 1/8 inches thick can be conveniently sawed by means of a portable electric hand saw now manufactured by the Wappat Gear Works, 58 N. Braddock Ave., Pittsburg, Pa. Equipped with special blades, the saw may also be employed for cutting fiber, bakelite, hard rubber, stone, steel, and other materials. Lumber ordinarily carried to a table saw can be conveniently cut off or ripped by means of this portable saw, thereby considering reducing handling time.

Safety is an important factor in a tool of this kind, and this has been provided for by furnishing the saw with a telescopic guard. This guard opens automatically when the saw is pushed into material, and closes automatically as the cut is completed. It affords maximum safeguard against accident and protects the blade from damage.

The tool is supported by a wide shoe which prevents tipping, and thus the effort of the operator is limited to merely guiding the saw. The shoe is adjustable, so that it is possible to set the saw for any depth of cut required in cutting out sections of flooring, etc. Sawdust is blown from the front of the saw by a blast of air coming from the motor ventilating fan. This blast keeps the path of the saw clear and enables the operator to cut accurately to a line. The motor is of the universal type which operates on either alternating or direct current, and has a rating of 3/4 horsepower. Timken tapered roller bearings are provided, and the drive is through worm-gearing. The circular blade is 9 inches in diameter, and the weight of the complete tool is about 30 pounds.

THOMPSON PORTABLE RUBBING MACHINE

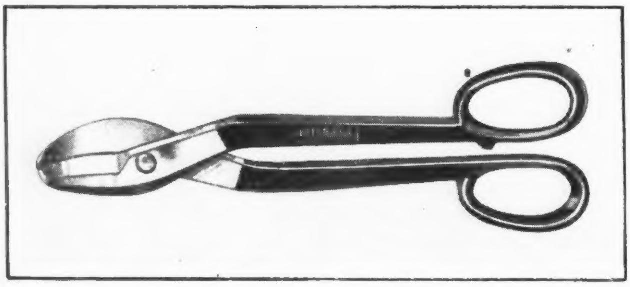
Convex, flat, and concave surfaces of wood and metal can be readily sanded, rubbed, or otherwise finished and polished by means of a portable machine recently brought out by the Thompson Rubbing Machine, Inc., Binghamton, N. Y. This machine is made in both floor and ceiling types. The floor type consists of a stand on which is mounted a motor drive


Thompson Rubbing Head for finishing Convex, Flat, and Concave Surfaces

to a flexible shaft. The flexible shaft is connected to a rubbing head, such as shown in the accompanying illustration. The ceiling type also embodies a motor drive to a flexible shaft connected to a rubbing head. Either wet or dry rubbing can be performed with the machine. The rubbing head has two reciprocating pads which are arranged flexibly to permit working on surfaces of any contour. These pads are detachable.

NIAGARA EXTRA-HEAVY CIRCLE SNIP

A No. 05 circle snip having a heavy curved lip has recently been placed on the market by the Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y. This device is intended for use in the automobile-body and similar industries. The curved lip enables the user to conveniently cut circles in soft steel sheets of No. 16 gage or lighter. The



Niagara Snip which may be used to cut Circles in Sheets

cutting edge of the snip, from the tip to the center of the bolt, is 6 inches, and the over-all length of the device is 16 inches.

"RED-LINE HOLEFINISHER"

An adjustable reamer with a single spiral blade is being placed on the market by the Modern Reamer Specialty Co., Millersburg, Pa., under the trade name of "Red-Line Holefinisher." The blade is of the shape seen in the lower portion of Fig. 1, and it is held in a spiral groove in the solid body. Set-screws are employed, as shown at *A*, Fig. 2, to hold the blade in the required position for an operation. The construction permits a large amount of blade adjustment, and enables regrinding of the blade many times, with an eccentric relief. The rigid body insures alignment and enables the reamer to be used for both roughing and finishing operations.

The blade is tilted forward for sharpening, as illustrated at *B*, Fig. 2, and positioned with the outer edge a few thousandths of an inch above the surface of the reamer body, the set-screws being adjusted to give the desired blade position. The blade is then ground by the usual cylindrical method, after which it is again tilted back against the wall

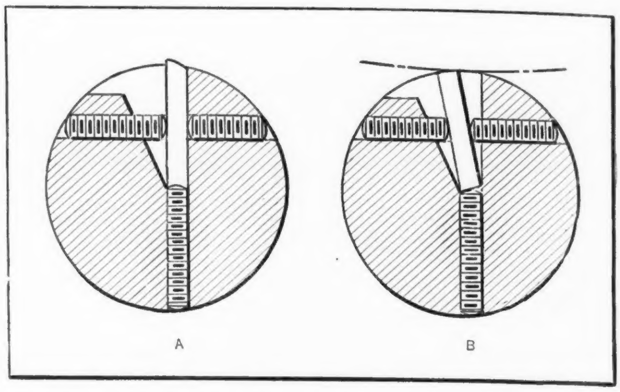


Fig. 2. Cross-sectional Views, showing the Reamer Blade set for Use, at A, and for sharpening, at B

of the body slot and gripped in the operating position by means of the set-screws.

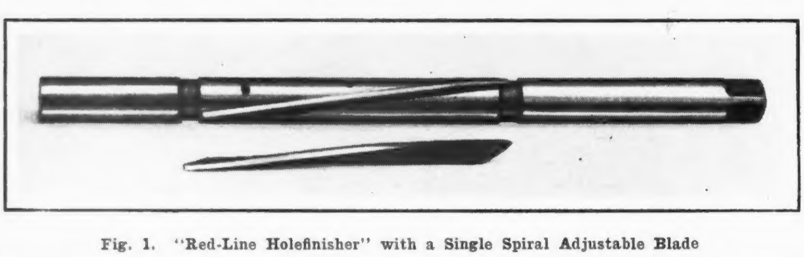
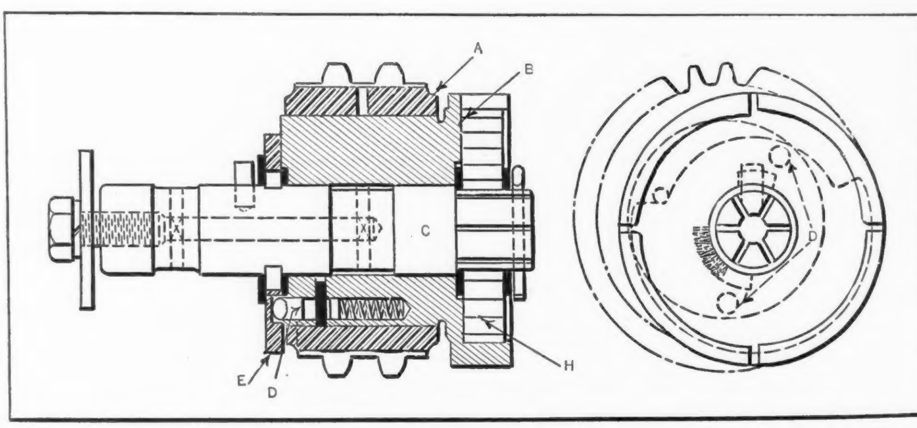


Fig. 1. "Red-Line Holefinisher" with a Single Spiral Adjustable Blade

LINK-BELT AUTOMATIC IDLER FOR SILENT CHAINS

An automatic idler and vibration damper for silent chain drives of machine tools is a new product of the Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill. This automatic device not only takes care of any elongation that may develop in a chain in service, but also saves the chain from the high inertia strains that are likely to be set up when there is lost motion between shafts. Thus the device tends to increase the life of the chain and insures quiet operation.

As illustrated, the device consists of an idler sprocket *A*, which is so mounted on an eccentric bushing *B* that it can revolve freely. The eccentric bushing, in turn, is mounted on a stationary shaft *C*, and any motion of the eccentric bushing is under the control of spiral spring *H*. As the chain becomes slack, spring *H* causes the eccentric bushing to revolve partially, so that the idler sprocket moves in a direction that will take up the slack. Two spring-actuated plungers *D*, which act as pawls, are in constant engagement with



Link-Belt Automatic Idler and Vibration Damper for Silent Chain Drives

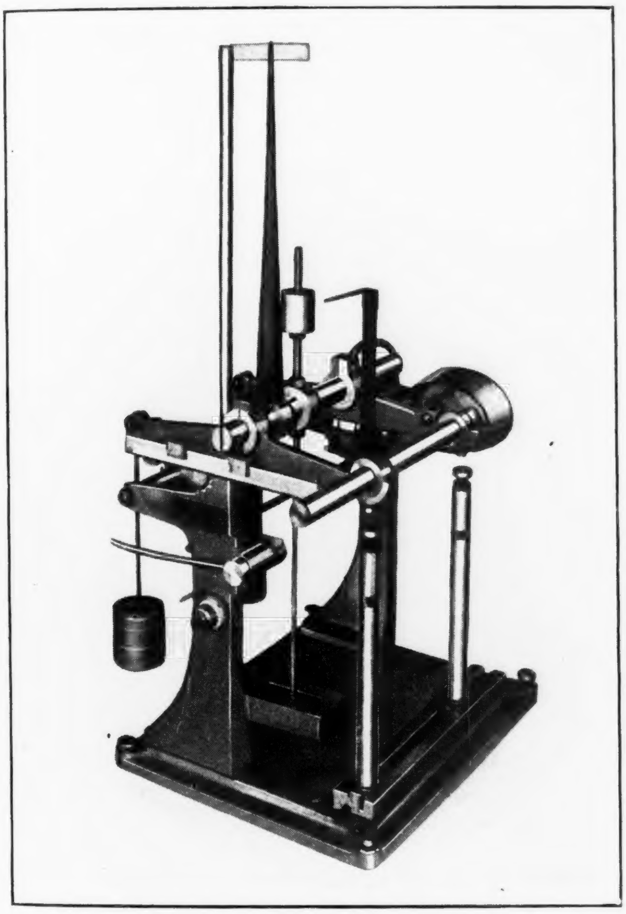
the ratchet plate *E*, so that when the eccentric bushing has revolved a distance equal to the pitch of the ratchet, the pawls hold the bushing against backward movement. This operation is repeated as further slackness occurs in the chain, and in this way, the idler automatically maintains the chain at the proper tension, and insures the desired speed relation between the driving and driven shafts.

Chain drives with automatic idlers can be applied to all styles of metal-working machines operated by motors having as high a rating as 25 horsepower, and in some cases, more than 25 horsepower can be transmitted. The position of the idler may be selected to suit conditions. No changes are required in

the location of the driving and driven units, it being only necessary to provide a stub shaft for the idler. It is good practice to encase the drive and operate it in a bath of oil. The idler is not affected by changes in the speed ratio of a drive. It can be installed in connection with either a main drive or an auxiliary drive.

OLSEN-LUNDGREN WEIGHING BALANCING SCALE

Flywheels, clutch members, and other parts to be balanced statically are mounted directly on the shaft of the latest Olsen-Lundgren automatic weighing balancing scale built by the Tinius Olsen Testing Machine Co., 500 N. 12th St., Philadelphia, Pa. The shaft on which the part is mounted is arranged to revolve four times per minute. In revolving the part approximately twice, the operator can obtain all the required data as to the amount of unbalance and angle of unbalance, and thus be in a position to accurately balance the part statically on a production basis.



Olsen-Lundgren Automatic Weighing Scale for Use in balancing Parts statically

Previously, this scale was made without the motor drive, and it was possible to balance 250 parts per day, but with the new motor-driven type here illustrated, as many as 500 automobile clutch parts are being balanced per day. The scale is built in various sizes, the larger machines accommodating heavy disks and other parts requiring static balance.

This motor-driven balancing scale will be demonstrated at the National Exposition of Power and Mechanical Engineering which is to be held at the Grand Central Palace, New York City, from December 6 to 11, inclusive.

PRODUCING UNIFORM ABRASIVE GRAIN

Slivers and plates in abrasive grain have a short life when put to work on the polishing wheel, and thus reduce the cutting ability of abrasives. Through the careful control of laboratory methods, the Carborundum Co., Niagara Falls, N. Y., is successfully eliminating plates and slivers from an improved aluminous oxide grain which is produced in electric furnaces. Aluminous abrasive grain made by the electric furnace is inherently glassy, and unless the crystallization is chemically controlled, when crushed, the product is likely to fracture into undesirable shapes. Control of the crystallization, therefore, is the first step to be taken, and this is accomplished by selecting all raw materials by chemical tests and carefully manipulating the furnace.

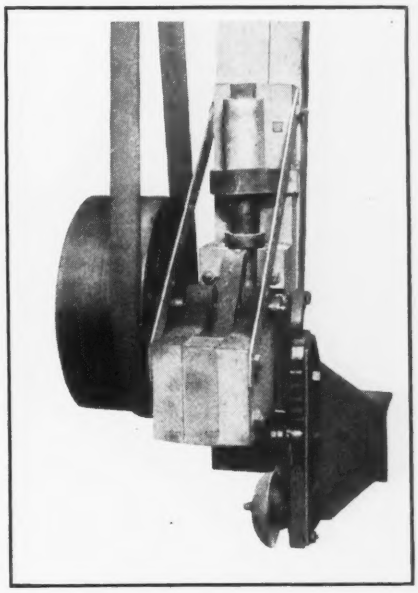
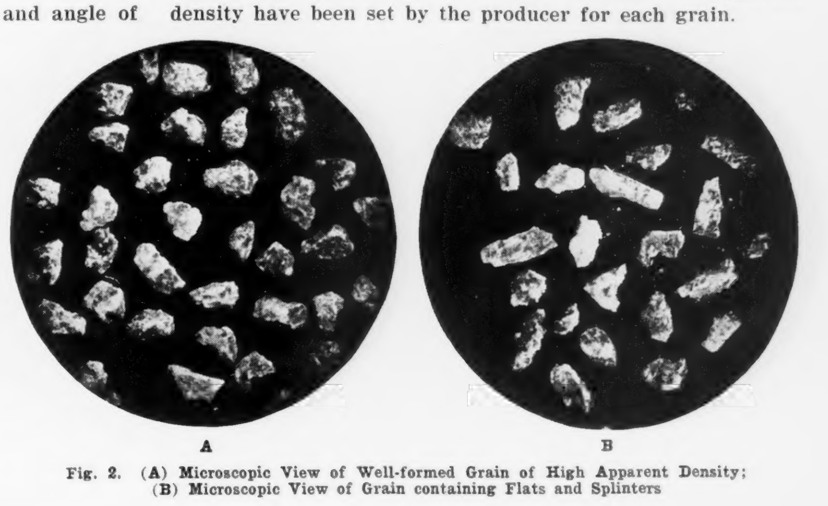


Fig. 1. Apparent Density Apparatus used in checking Uniformity of Grain

In the operation of crushing, the flats, plates, and splinters are broken into pieces that have approximately the same dimension in three directions, and all jagged twin particles are crushed into a uniform shape. Finally, the sifting operation is performed on patented screening machines that grade the particles according to the shortest dimension, so that any splinters having one dimension equal to, say, the No. 24 grain and another equal to the No. 46 grain, pass through the screen with No. 46 particles. Thus, the No. 24 grain is made stronger by the absence of particles having one dimension equal to the No. 46 grain.

When the grain has been passed through the grading process, every pound is subjected to an "apparent density" or "bump" test, which is also sometimes referred to as a determination of the "packing effect" of the graded grits. This operation consists of bumping or jolting a known weight of each variety of grain in a vessel, and then measuring the volume occupied by the abrasive. The grain that packs best is of high "apparent density" and is that which is most uniformly shaped. The grain shown at *A*, Fig. 2, is well shaped, and has an apparent density of 2.35. The grain shown at *B* was graded to exactly the same size, but it is splintered and has an apparent density of 2.08. The former grain is evidently the more desirable. Minimum standards of apparent density have been set by the producer for each grain.



A B

Fig. 2. (A) Microscopic View of Well-formed Grain of High Apparent Density; (B) Microscopic View of Grain containing Flats and Splinters

The apparent density test is conducted with the equipment illustrated in Fig. 1, which consists of a brass cylinder 15 inches deep and 1 1/2 inches in diameter. Into this cylinder, 350 grams of grain are placed, and the cylinder is jolted up and down mechanically 200 times. With each revolution of a cam, the cylinder is raised about 3 inches and dropped on a wooden base. At the end of the bumping period, the volume occupied by the packed grain is measured by placing a graduated cylinder inside the jolted cylinder until the level of the grain is reached. From the volume of the grain and its weight, the apparent density can be calculated by simple division.

* * *

THE FRENCH MACHINE INDUSTRY

The Industrial Machinery Division of the Department of Commerce has compiled some interesting information relating to the machine industry of France, based upon a report by Assistant Trade Commissioner F. P. Waller of Paris. Under the Treaty of Versailles, France took over the iron and steel producing area of Alsace-Lorraine, with the result that France now occupies a much more important position in the iron and steel field than in pre-war years. Also, the industry in Luxemburg was formerly more closely related to Germany than to Belgium, but since the war it is more closely tied with Belgian and French interests. Consequently, France is now the greatest factor in the iron and steel industry on the continent of Europe.

Because of this increased capacity for the production of iron and steel, the French machinery industry has also been stimulated. Notwithstanding the greatly increased domestic consumption, France imported 50,000 tons less machinery in 1925 than in 1913, a reduction of 40 per cent in the pre-war imports. On the other hand, France exported 50,000 tons more in 1925 than in 1913, increasing her machinery exports 185 per cent. Including the domestic business done in France by domestic manufacturers of machinery, it is estimated that the production of all classes of industrial equipment in 1925 was, in volume, two and one-half times as great as in 1913, showing that France has become a new factor in the world's machine-building industry.

War-time Machinery is Now Absorbed

The armistice found large quantities of American machinery in France, both in the hands of the government and in the hands of machinery dealers. This equipment has been used to replace machinery in shops damaged by the war and for equipping new plants. At the present time, practically all this machinery has been absorbed, although the installation of this modern machinery in many plants throughout the country undoubtedly still has an effect on the machinery imports of France. The average French manufacturer is less inclined to discard an old machine than is an American firm, and hence, there is less likelihood of immediate replacement of this recently installed equipment.

Furthermore, many French manufacturers, because of the continuing depreciation of the franc, placed their reserves in commodities less likely to depreciate, and consequently made heavier purchases of industrial machinery than they would have done under normal conditions; and while French production in many directions has increased considerably, there is a fair amount of equipment on hand in good condition to take care of this expansion.

In 1913 Germany was by far the most important source of supply for French machinery imports, furnishing 46 per cent of the total; Great Britain furnished 26 per cent; Belgium, 14 per cent; the United States, 6 per cent; and Switzerland, 5 1/2 per cent. These figures apply to industrial machinery used in manufacturing plants, as well as to locomotives, sewing machines, and printing machinery. During recent years the American position in this market has greatly improved.

Metal-working Machinery

Referring now specifically to metal-working machinery, it should be noted that the increased iron and steel capacity of the country, the expansion in the automobile and the agricultural implement fields, and the pressure of the war, have stimulated the production of metal-working machinery within the borders of France. The expansion in this field is probably greater than that in any other class of machinery. It is estimated that the present French production of metal-working machinery is more than three times the volume in 1913. At that time France imported 23,700 tons of metal-working machinery, while in 1926, the imports amounted to only 12,500 tons. Meanwhile, the exports of metal-working machinery from France rose from 3770 tons to 11,170 tons. Clearly, the French manufacturers of metal-working machinery now occupy a new position in the world's markets.

In 1913, Germany supplied 50 per cent, Great Britain about 21 per cent, and the United States about 17 per cent of the metal-working machinery imports. In 1925, this ratio had changed. Germany furnished about 32 per cent; Great Britain, 12 per cent; and the United States, 26 per cent of the imports.

Since 1922, the exports of metal-working machinery from the United States to France have steadily increased. In 1922, the value was slightly more than one million dollars. In 1925, it was close to $2,500,000, making France one of the most important markets for American metal-working machinery. This increase in American participation in the French market has taken place in the face of determined competition from both Germany and Great Britain, who, due to their proximity to France, enjoy advantages over the manufacturers in the United States. The strength of the American position is best indicated by the continuous increase in sales in France in spite of the handicap of greater distance.

* * *

TWENTY-FIFTH ANNIVERSARY OF BUREAU OF STANDARDS

On December 4, the Bureau of Standards, Washington, D. C., will celebrate its twenty-fifth anniversary. During the day the laboratories of the bureau will be kept open for inspection, and in the evening the bureau will entertain a group of distinguished guests at dinner. The event is of interest to both the scientific and industrial fields with which the bureau works in close cooperation.

* * *

TRADE NOTES

General Electric Co., Schenectady, N. Y., has announced a reduction averaging 5 per cent in the price of distribution and small power transformers, effective November 8.

Hydraulic Press Mfg. Co., Mount Gilead, Ohio, has opened completely equipped sales and engineering offices in Columbus, Ohio. The new offices are under the direction of Paul C. Pocock.

American Hammered Piston Ring Co. has taken new and larger quarters in San Francisco, Cal., at 677 Folsom St. The new quarters include a warehouse as well as offices. T. Latimer Ford is in charge.

Ekins Tool & Die Co. has been organized at Buchanan, Mich., by W. J. S. Ekins, formerly mechanical engineer for the Michigan Toy Co. The new firm will engage in the building of special machinery and machine tools and in die making and designing.

Royersford Foundry & Machine Co., Inc., has moved the general sales office of the company from 52 N. 5th St., Philadelphia, Pa., to the plant at Royersford, Pa. The office in Philadelphia is being retained as a city sales office, with H. S. Weigand in charge.

Rollway Bearing Co., Inc., Syracuse, N. Y., has appointed John Parker New England representative of the company. Mr. Parker has been connected with the Brown & Sharpe Mfg. Co. for eleven years, and with three other equipment manufacturers for more than fifteen years.

Geometric Tool Co., New Haven, Conn., Westville Sta., manufacturer of special machinery and tools for cutting screw threads, announces that R. S. Stokvis & Fils, of 20-22 Rue des Petits Hotels, Paris, France, have been appointed exclusive agents for the company in France.

RYERSON
MACHINERY
FOR ALL PURPOSES
Long years of experience with production problems in many industries have produced a remarkably efficient machinery organization.
Ryerson engineers are at your service to help solve your equipment or production problems. A word from you will bring our representative or catalog.
Lathes
Drills
Planers
Shapers
Punches
Shears
Motors
Bulldozers
Small Tools
Friction Saws
Bevel Shears
Milling Machines
Horizontal Drills
Power Hammers
Bending Rolls
Pneumatic Machinery
Serpentine Shears
Hydraulic Machinery
Spring Shop Equipment
Flue Shop Equipment
JOSEPH T. RYERSON & SON INC.
Chicago, Milwaukee, New York, Buffalo,
St. Louis, Detroit, Cincinnati, Boston

Chain Belt Co., Milwaukee, Wis., manufacturer of elevating and conveying machinery, has taken over the Stearns Conveyor Co., of Cleveland, Ohio, engineers and manufacturers of belt conveyors. The latter company will continue to operate as a separate corporation, with Earl D. Stearns acting as president.

D. C. Oviatt & Co., 2160 Lakeside Ave., Cleveland, Ohio, dealers in new and used machinery, are disposing of the equipment of the Cleveland Steel Co., Cleveland, Ohio, consisting of heavy gate shears, complete rolling mill, Mesta mill-type engine, air compressors, bending rolls, and complete machine shop equipment.

Harry A. Scott Co., formerly located at 432 W. Main St., Kalamazoo, Mich., has moved into larger quarters at 229 E. Main St. of the same city, where floor space of 100,000 square feet will be available. The company builds special machinery and does general contract machine work. Harry A. Scott is president and general manager.

Automatic Machinery & Equipment Co., 150 Nassau St., New York City, announces that its corporate name has been changed to Hires, Castner & Harris, Inc. The firm is engaged in consulting engineering work, including plant engineering, industrial research work, designing and building of special machinery, and the installation of modern production methods.

Botfield Refractories Co., Swanson and Clymer Sts., Philadelphia, Pa., has appointed the following companies distributors for "Adamant" fire-brick cement: Westwater Supply Co., 150 N. 3rd St., Columbus, Ohio; Klinger-Dills Co., 129 N. Jefferson St., Dayton, Ohio; Coan Equipment Co., 236 Murray St., Fort Wayne, Ind.; and Cleveland Tool & Supply Co., 1427 W. 6th St., Cleveland, Ohio.

Kalamazoo Spoke & Nipple Co., formerly located at 418 E. Myrtle St., Kalamazoo, Mich., has moved into its new building on East Kalamazoo St. of the same city, where floor space amounting to 16,000 square feet will be available. This company has absorbed the plant of the Cook Standard Tool Co., which in the future will be known as the Standard Tool & Die Co., Division of the Kalamazoo Spoke & Nipple Co. E. C. Bowers is general manager.

Link-Belt Co., Chicago, Ill., announces that the horsepower range of Link-Belt silent chain drives available from distributors' stocks has been extended. At present the available range is from 1/2 to 10 horsepower in practically any reduction from 1 to 1, to 7 to 1. In the future, the range kept in stock by distributors will be up to 15 horsepower; but it should be understood that the company is also prepared to furnish engineering drives up to, and even above, 1000 horsepower.

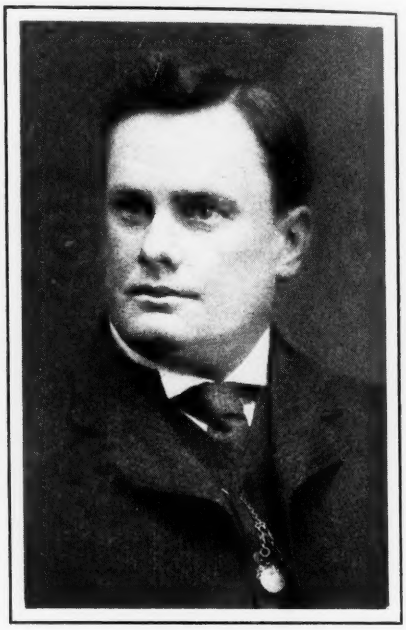
Samuel C. Rogers & Co., Buffalo, N. Y., in order to correct certain misunderstandings in the trade, inform us that they have not sold or transferred the whole or any part of their business of the Rogers knife grinders and saw sharpeners, of which they are the originators and sole manufacturers. They further state that they have not given any rights or privileges to others to use the name Rogers in connection with such machinery, and will regard any such use of that name as an infringement. The business was started almost forty years ago by Samuel C. Rogers, who placed automatic knife grinders and saw sharpeners on the market, and has been continued ever since by him and his successors. The company is now building a new factory and enlarging its facilities with a view to increasing its output.

Whitman Barnes-Detroit Corporation, formed September 1 as the result of the merger of the Whitman & Barnes Mfg. Co., Akron, Ohio, and the Detroit Twist Drill Co., Detroit, Mich., announces the election of the following officers: President, William H. Eager, formerly president of the Whitman & Barnes Mfg. Co.; vice-president, Muir B. Snow, formerly president of the Detroit Twist Drill Co.; and secretary and treasurer, Karl Kendig, formerly secretary and assistant treasurer of the Whitman & Barnes Mfg. Co. The directors of the new company are A. H. Commins, W. J. O'Neill, A. D. Armitage, C. H. Hecker, H. H. Sanger, and J. H. Hamblem, Jr. H. Z. Callender, formerly sales manager of the Whitman & Barnes Mfg. Co., becomes sales manager of the new company. Ralph Hammersley, formerly superintendent of the Whitman & Barnes works, is chief engineer of the corporation, and J. A. Dietrich, formerly superintendent of the Detroit Twist Drill Co., is superintendent of the new organization. The plants operated by both companies prior to the merger are to be maintained for the present. Gradually, as expanded facilities in Detroit permit, the Akron force will be moved to Detroit. The executive offices are now located in Detroit. The warehouses and branches maintained by the Whitman & Barnes Mfg. Co. in New York and Chicago will be continued, with Frank W. Oliver in charge in New York, and M. J. Kearins in Chicago. A new branch at Detroit, comprising that city and the southern Michigan territory, has been created with A. B. Hall in charge.

OBITUARIES

E. F. ABBEY

E. F. Abbey, president and general manager of the Etna Machine Co., Toledo, Ohio, died at his home in Toledo on November 8. Mr. Abbey was born in Batavia, Ill., December 11, 1864. In the spring of 1883 he started to learn the machinist's trade, entering the employment of the U. S. Windmill Co., Batavia, Ill., as an apprentice. In 1887, Mr. Abbey went to Toledo where he was employed as a machinist by the Vulcan Iron Works, Toledo Foundry & Machine Co., and the Milburn Wagon Works, successively.



As Mr. Abbey's experience in the trade broadened, he gained a considerable reputation as a die-sinker, men with such knowledge being in demand during the period that the bicycle industry was flourishing. At this time, Mr. Abbey worked for the Snell Cycle Co. and the Yost Mfg. Co. in Toledo, Ohio. He continued in that capacity until 1897, when he saw that the demand for bicycles was rapidly slackening. This led him to a change of employment, and he entered the plant of the Ames-Bonner Brush Co. as tool-room foreman. During the period from 1897 to 1901, Mr. Abbey developed various special machines and tools used in the manufacture of brushes. Notable among these were two special machines—one for boring the holes in brush backs to receive the bristles, and the other for automatically "filling" the bristles in the brush. Patents on these machines were taken out in Mr. Abbey's name.

In 1901, in partnership with C. A. Byers, he formed the Etna Machine Co., Mr. Byers holding the office of president, and Mr. Abbey the offices of vice-president and general manager. In 1909, the company was incorporated, the officers remaining the same until 1915, when at the death of Mr. Byers, Mr. Abbey assumed the position of president and general manager, which he held until the time of his death. The Etna Machine Co. was formed with a view to building machinery for use in the manufacture of brushes, but later developed and manufactured the well-known line of swaging machines which are identified both with the name of this company and with the creative genius of Mr. Abbey.

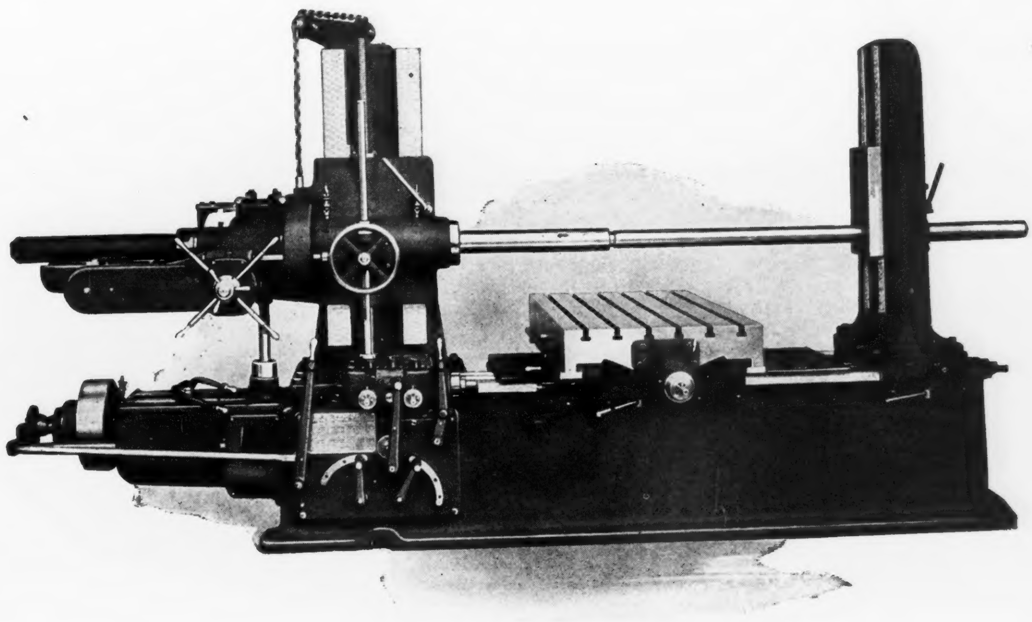
CHARLES G. CHISHOLM

Charles G. Chisholm, general manager of the Haynes Stellite Co., died October 21 at Kokomo, Ind., after but one week's illness, death resulting from acute inflammation of the liver. Mr. Chisholm was born in Nova Scotia in 1886, of Scotch parentage. His early life was spent in California, and his first business connection was with the Southern Pacific Railroad, with which company he rose to the position of general passenger agent at Seattle, Wash.

In 1915 he left the Southern Pacific to become affiliated with the Union Carbide Co. at San Francisco. He was transferred to the New York office of the company in 1917, and when the Haynes Stellite Co. was acquired by the Union Carbide & Carbon Corporation in 1920, Mr. Chisholm became general sales manager of this company. In 1925 he was made general manager.

The success of this company is in no small measure attributed to Mr. Chisholm's leadership and genius for organization. He had great vision and business foresight, and was largely responsible for the increasing use of stellite in the metal cutting field, as well as for the application of stellite to metal parts subject to heat and wear.

G. A. Sacchi, manager of the stoker sales department of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., died suddenly on November 4 at his residence in South Lansdowne Ave., Lansdowne, Pa.

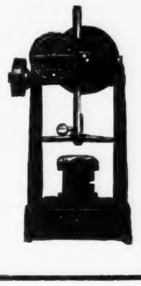


A Record is better than a Promise

and we cannot afford to not live up
to the record of the

"PRECISION"

We also make the



LUCAS POWER Forcing Press

Boring Drilling and MILLING MACHINE

Therefore our customers are safe

THE LUCAS MACHINE TOOL CO., Cleveland, Ohio, U.S.A.

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo. Ing. M. Kocian & G. Nedela, Prague. Schuchardt & Schutte, Berlin.

PERSONALS

LEON E. HAYNES has been appointed assistant advertising manager of the Buffalo Forge Co., Buffalo, N. Y.

WILLIAM P. WOODSIDE has recently been appointed president of the American Twist Drill & Tool Co., Detroit, Mich.

R. M. BAYLE has been appointed service manager in charge of the new Fairmont service station of the Westinghouse Electric & Mfg. Co., with headquarters at Fairmont, W. Va.

JAMES W. BARR, formerly connected with the New York office of Manning, Maxwell & Moore, has been made Chicago sales engineer for the New Britain Machine Co., New Britain, Conn.

J. E. SMITH, for the last seven and one-half years works superintendent of the Mansfield plant of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been appointed director of manufacturing methods and machine tool equipment.

EVAN J. PARKER, formerly with the Morgan Engineering Works, Alliance, Ohio, has joined the Northern Engineering Works, Detroit, Mich., makers of material handling equipment, foundry equipment, etc. Mr. Parker will have charge of the sales promotion division.

M. I. DORFAN has been appointed engineer of the dust collecting department of the Pangborn Corporation, Hagerstown, Md. Mr. Dorfan was formerly connected with the Allis-Chalmers Mfg. Co., and has also had experience with other manufacturers of dust collectors.

E. J. HORNBERGER has become identified with the W. E. Shipley Machinery Co., of Philadelphia, Pa., in the sale of machine tools in that city and vicinity. For the last seven years, Mr. Hornberger has been chief engineer of the firm of Bardons & Oliver, turret machinery manufacturers, of Cleveland, Ohio.

PAUL T. IRVIN, for a number of years manager of the small tool department of the Greenfield Tap & Die Corporation, Greenfield, Mass., has assumed charge of sales for Bemis & Call, of Springfield, Mass., manufacturers of wrenches. Louis Battey has been appointed manager of the small tool department of the Greenfield Tap and Die Corporation to succeed Mr. Irvin.

R. E. HELLMUND, formerly engineering supervisor of development with the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been made chief electrical engineer. A. M. DUDLEY, formerly manager of the automotive equipment engineering department, has been appointed engineering supervisor of development to fill the position left vacant by Mr. Hellmund's promotion.

E. HAROLD NEELY is now covering Greater New York and the New England states for the Royersford Foundry & Machine Co., Inc., Royersford, Pa., manufacturer of power transmission machinery, punches and shears, tumbling barrels, etc. J. J. DUNPHY will have charge of the New York, Pennsylvania, Delaware, and Maryland territory. Harry A. Lyon, formerly of the Bock Bearing Co., will care for the company's interests in the states just west of Mr. Dunphy's territory.

WILLIAM ALTHOFF, assistant chief of the Industrial Machinery Division, Department of Commerce, Washington, D. C., has joined the export organization of the Studebaker Corporation of America, and will act as special representative of the company for Mexico and Cuba, supervising the factory's dealer agents in that region. Before entering the employ of the Department of Commerce, Mr. Althoff resided for ten years in Latin America, where he was engaged in the sale of automobiles, machinery, and similar products. Prior to that, he was associated for a number of years with a large New York exporting organization.

COMING EVENTS

DECEMBER 1-3—Tractor meeting of the Society of Automotive Engineers to be held at the Hotel Sherman, Chicago, in cooperation with the American Society of Agricultural Engineers. Coker F. Clarkson, 29 W. 39th St., New York City, secretary.

DECEMBER 6-9—Annual meeting of the American Society of Mechanical Engineers at the Engineering Societies' Building, 29 W. 39th St., New York City. Calvin W. Rice, secretary.

DECEMBER 6-11—Fifth national exposition of power and mechanical engineering at the Grand Central Palace, New York City. Managers of the exposition: Charles F. Roth and Fred W. Payne of the International Exposition Co., Grand Central Palace, New York.

JANUARY 8-15—National Automobile Show to be held in New York City under the auspices of the National Automobile Chamber of Commerce, 366 Madison Ave., New York City.

JANUARY 25-28—Annual meeting of the Society of Automotive Engineers in Detroit. Coker F. Clarkson, 29 W. 39th St., New York City, secretary.

JANUARY 29-FEBRUARY 5—National Automobile Show to be held in Chicago, Ill., under the auspices of the National Automobile Chamber of Commerce, 366 Madison Ave., New York City.

MAY 25-28—Spring meeting of the Society of Automotive Engineers at French Lick Springs, Ind. Coker F. Clarkson, 29 W. 39th St., New York City, secretary.

NEW BOOKS AND PAMPHLETS

A FUNDAMENTAL BASIS FOR MEASUREMENTS OF LENGTH. By H. W. Bearce. 14 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 535 of the Bureau of Standards. Price, 5 cents.

SKETCHES AND WORKING OF OIL ENGINES. By Julius Kuttner. 86 pages, 10¼ by 13½ inches. Published by the Freeman-Palmer Publications, 220 W. 42nd St., New York City. Price, $3.50.

The oil engine's rapidly increasing importance as a prime mover in the automotive, stationary, and marine fields is creating an active demand for information on this subject. To meet this demand, *Motorship* has published a series of articles on the oil engine, which are now available in book form. These articles outline the principles underlying the various designs of oil engines and describe the methods of working. The book is intended for students, operating engineers, and designers.

WAGE SCALES AND JOB EVALUATION. By Merrill R. Lott. 161 pages, 5½ by 8½ inches. Published by the Ronald Press Co., 15 E. 26th St., New York City. Price, $5.

This book deals with the scientific determination of wage rates on the basis of services rendered—an important problem of present-day management. The purpose of the book is to serve as a practical guide. It does not deal with theories of wages or the economics of compensation, but presents the results of extensive actual experience in developing an equitable wage program for a manufacturing concern. The methods described have been applied with success, and possess desirable features which appear to be of general application and should be of suggestive value. The solution of the problem is a system of wage scales developed from an evaluation of occupational factors by means of a carefully worked out system of ratings.

TOOL CONTROL. By Anker L. Christensen. 134 pages, 5½ by 8½ inches. Published by the Ronald Press Co., 15 E. 26th St., New York City. Price, $3.50.

The purpose of this book, as stated in the preface, is to apply the accumulated knowledge and experience on the subject of tool control to a specific problem, that is, the installation of an efficient tool control system that will cover the requirements of large factories and yet be elastic enough to suit the needs of small ones. The subject is divided into six main parts, as follows: Procurement, storage, issue, use, repairs, and cost. The problem is not treated from a theoretical standpoint, but actual information is given on the organization of a tool control system based on the result of actual standardization of a large tool-crib in an important industrial plant. The book contains ten chapters headed as follows: Preliminary Analysis; Tool Classification; The Tool-crib; Bringing Tools Under Control; Methods of Issuing Tools; Tool Inspection; Allocation of Cost; Executive Control; Tool-crib Personnel; and Tool Development.

THOMAS' REGISTER OF AMERICAN MANUFACTURERS. 4500 pages, 9 by 12 inches. Published by the Thomas Publishing Co., Inc., 461 Eighth Ave., New York City. Price, $15.

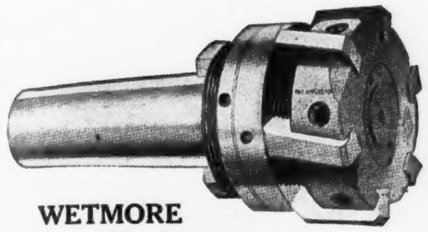
This is the seventeenth edition of this well-known directory of American manufacturers. The new edition embodies more than 250,000 changes, but the arrangement is the same as previous editions. Following the index to advertisers comes the index or finding list of the products covered by the book, arranged alphabetically, and printed on yellow paper. The principal section of the book contains a classified list of the products, arranged alphabetically, with the names and addresses of the manufacturers arranged according to geographical location. This section covers 3527 pages, and is printed on white paper. Following the classified section, is given a list of representative banks, boards of trade, chambers of commerce and similar organizations, and trade papers. The alphabetical list of manufacturers is printed on blue paper, and covers 468 pages. In many cases, the branches and names of officers are included. The trade name section of the book, printed on pink paper, covers 363 pages, and contains a list of all the trade names of the products included in the index. The book has been thoroughly revised and brought up to date, and will be found an invaluable guide by purchasers of all classes of manufactures.

NEW CATALOGUES AND CIRCULARS

BALL BEARINGS. New Departure Mfg. Co., Bristol, Conn. Loose-leaf sheets dealing with the subject of advantages of ball bearings in electric motors.

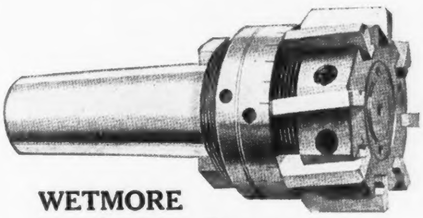
TRUCKS. Clark Tructractor Co., 1102 Days Ave., Buchanan, Mich. Catalogue illustrating different styles of Clark trailers, and giving dimensions, capacities, etc.

NICKEL STEEL. International Nickel Co., 67 Wall St., New York City. Circular outlining the advantages of nickel steel, and illustrating various applications.



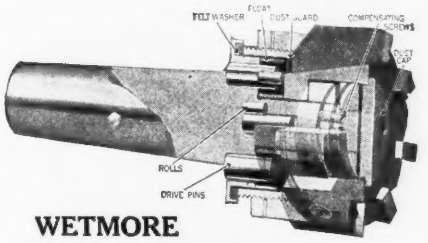
WETMORE
Roughing Reamer

—designed to withstand the initial reaming operation. Its blades are set at a right-hand angle. The sturdiness and rigidity of this tool enable it to remove an unusually large amount of stock.



WETMORE
Semi-finishing Reamer

—or intermediate tool, has left-hand angle blades, which eliminate "digging in" and chatter. Free cutting—a straight, round hole with no scoring when backing out after the cut is the result—a condition ideal for the work of the Wetmore Finishing Reamer.



WETMORE
Finishing Reamer

Float-in-head design, with blades set at left-hand angle. Blades are held rigidly and are staggered to give a reaming action obtained by no other tool. This feature eliminates the need of grinding the cylinders. The most prominent feature of the Wetmore Finishing Reamer is the location of the float—in the head of the tool, where it belongs. Being in the head, directly under the strain, there is no tendency to get out of parallel and to "cramp". The float is an improved Oldham Float with rollers, but no sliding contact. This eliminates friction. The Wetmore mechanism is thoroughly protected from dust and grit, a cap covering the front and a washer protecting the back.

The bodies, cone and lock nuts of these reamers are of alloy steel, heat-treated.

Why Wetmore Cylinder Reamers Speed Production

Unusual *durability* and *sturdiness*, plus *greater working speed* and *less vibration*—that's the combination you get in these three adjustable Wetmore Cylinder Reamers!

Note the extreme ruggedness of the Roughing Reamer. The Semi-Finishing Reamer, with its left-hand angle blades, eliminates digging in and chattering. It assures a straight, round hole with no scoring. The construction of the Finishing Reamer assures a smooth, glass-like finish to the cylinder wall.

Wetmore Cylinder Reamers are standard in many of the largest motor manufacturing plants. A trial in your shop, in competition with other reamers, will prove that they save time and money.

Send for Catalog No. 26, showing full line of Wetmore Adjustable Reamers, including standard, heavy-duty, shell, small machine, and cylinder reamers. Also arbors and replacement blades.

WETMORE REAMER COMPANY
60 27th Street, Milwaukee, Wis.

WETMORE ADJUSTABLE REAMERS

"THE BETTER REAMER"

HARDENING EQUIPMENT. Stanley P. Rockwell Co., 66 Trumbull St., Hartford, Conn. Bulletin 2610-B, showing typical hardening curves for different kinds of steel.

CHUCKS. Skinner Chuck Co., New Britain, Conn. Bulletin 40-A, containing data including complete dimensions of Skinner air-operated wrenchless chucks, air cylinders, and equipment.

GEARS. Boston Gear Works Sales Co., Norfolk Downs, Mass. Booklet entitled "Parallel Drives," containing dimensions and price lists of Boston standardized spur gears for parallel drives.

ELECTRIC FITTINGS. Crouse-Hinds Co., Syracuse, N. Y. Folder 43, illustrating and describing plug receptacles and safety switch condulets. Bulletin 2093 containing prices of safety switch condulets.

CENTRIFUGAL PUMPS. Ingersoll-Rand Co., 11 Broadway, New York City. Bulletin 7059, describing Cameron single-stage double-suction volute centrifugal pumps, and illustrating various installations of these pumps.

BRIDGE-OPERATING POWER UNIT. Earle Gear & Machine Co., 4707-15 Stenton Ave., Philadelphia, Pa. Circular descriptive of the Earle power unit for operating bridges, lock gates, large valves, and similar purposes.

CRUCIBLES. Plumbago Crucible Association, 90 West St., New York City. Pamphlet entitled, "How to Make an Inexpensive Storage Oven," descriptive of the requirements for a storage oven that will properly safeguard crucibles.

FLEXIBLE COUPLINGS. W. H. Nicholson & Co., 114 Oregon St., Wilkes-Barre, Pa. Bulletin 1026, illustrating and describing the Nicholson flexible coupling. A table of dimensions, weights, and prices, covering the complete range of sizes, is included.

STEEL WHEELS AND AXLES. Carnegie Steel Co., Carnegie Bldg., Pittsburg, Pa. Pamphlet entitled "Wrought Steel Wheels and Other Circular Sections—Forged Steel Axles," containing data, tables, and specifications pertaining to the design of these parts.

MILLING MACHINES. Kearney & Trecker Corporation, Milwaukee, Wis. Leaflet designated Lay-out No. 20, illustrating the application of a special two-spindle milling head to a standard No. 4B plain Milwaukee milling machine, for milling bearing pads on steel truck frames.

INDUSTRIAL HEATERS. Buffalo Forge Co., 144 Mortimer St., Buffalo, N. Y. Catalogue 466, descriptive of the various types of Buffalo unit heaters, including "Breezo-Fin" heaters, "Vento" heaters, "Hi-pressure" unit heaters, and direct-fired heaters. Applications for the different types are suggested.

ELECTRICAL EQUIPMENT. Brown & Pengilly, Inc., 1264 Folsom St., San Francisco, Cal. Loose-leaf catalogue No. 3, covering the line of electrical equipment made by this concern, including switchboards, panel boards, electric switches, insulating panels, testing equipment, fire alarm systems, etc.

WIRE SPRING COILING MACHINES. Sleeper & Hartley, Inc., Worcester, Mass. General bulletin No. 101, containing tables of capacities of the universal wire spring coiling machines made by this company. The bulletin describes the two different types of machines made, namely, the segment and clutch types.

SPEED REDUCERS. Foote Bros. Gear & Machine Co., 232-242 N. Curtis St., Chicago, Ill. Pamphlet containing lubrication instructions for IXL spur gear, herringbone gear, and worm-gear speed reducers. The leaflet describes the construction of the various types and the oiling systems. It also recommends the grades of oil to be used in each case.

VERTICAL SLIDE TOOL FOR TURRET LATHES. Warner & Swasey Co., Cleveland, Ohio. Pamphlet descriptive of a vertical slide tool for performing boring, recessing, back-facing, chamfering, or necking operations on turret lathes. This tool is applicable to the Warner & Swasey standard turret lathes, and to other makes of turret lathes as well.

REAMERS. McCrosky Tool Corporation, Meadville, Pa. Catalogue 10, of McCrosky-Super adjustable reamers; "Ideal" railroad reamers; McCrosky floating holders for reamers, taps, etc.; Wizard quick-change chucks and collets; McCrosky turrets and steadyrests; "Nevastop" faceplates; and "Searchlight" lamp brackets. Price lists of the various tools are included.

MILLING VISE AND QUICK-CLAMP LOCKS. Universal Standard Sales Co., Woodward at Grand, Detroit, Mich. Circular illustrating and describing the quick-clamp milling vise made by the Michigan Machine Co., of Detroit. Working drawings and a chart of dimensions are shown. Circular containing dimensions and working drawings of quick-clamp locks for fixtures, vises, etc.

TURRET LATHE TOOLS. Gisholt Machine Co., 1300 E. Washington Ave., Madison, Wis. Catalogue containing complete data covering the line of standard tools for Gisholt small turret lathes. In addition to showing the tooling equipment, the catalogue also contains views of the plant, as well as illustrations of Gisholt small turret lathes, which are made for both bar and chucking work.

ROLLER BEARINGS. Timken Roller Bearing Co., Canton, Ohio. Reprints in illustrated booklet form of the paper on "Recent Developments in the Application of Tapered Roller Bearings in Machine Tools," presented by S. M. Weckstein, industrial equipment engineer of the company, before the machine tool section of the American Society of Mechanical Engineers at the New Haven meeting in September.

CASEHARDENING COMPOUND. Kasenit Co., 122 Greenwich St., New York City. Booklet treating of the subject of open-hearth hardening. Information is given on the methods of testing the hardness and toughness of metal, and the application of "Kasenit," a non-explosive casehardening compound. The booklet also contains data on heat temperatures and colors for hardening, the melting point of metals, etc.

HYDRAULIC PRESSES. Hydraulic Press Mfg. Co., Mount Gilead, Ohio, is distributing the first issue of a quarterly publication known as *The Hydraulic Press*, which will contain articles on the multiple uses of hydraulic equipment, and will show typical installations. Articles of wide general interest, as well as of specific application, will appear, and the methods and processes of some large manufacturing plants will be illustrated and described.

ELECTRICAL EQUIPMENT. Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Folder 4474, describing the babbitting of bearings and explaining the use of Westinghouse automatic electric babbitting pots. The folder also describes the lead base babbitt, alloy No. 25. Publication S.P. 1767, entitled "The Arc Welding of Structural Steel," dealing with the application of the arc welding process in the erection of steel buildings.

HOBS AND MILLING CUTTERS. Barber-Colman Co., Rockford, Ill. Catalogue G, covering the line of hobs, milling cutters, and machine tools made by this concern. The booklet contains a complete list of the standard cutters carried in stock, including prices. Information is also given on special tools, and how to order them. The sizes of cutters listed are in accordance with Simplified Practice Recommendation No. 36, endorsed by the United States Department of Commerce. The last section of the book contains useful general information, including tables of cutting speeds; gear information; high-speed steel weights of rounds, flats, and squares; tapers; etc.

MILLING CUTTERS. Goddard & Goddard Co., Hastings at Forest, Detroit, Mich. Catalogue C, containing 224 pages, 5 by 7½ inches, devoted exclusively to milling cutters. This is the latest edition of the general catalogue of "Go and Go" special and standard milling cutters. In addition to giving dimensions and price lists of the complete line of "Go and Go" milling cutters, general information of interest to those using milling cutters is included, such as grinding of form cutters; some essentials of good milling; milling heat-treated steels; speeds and feeds for high-speed milling cutters; tables of cutting speeds, decimal equivalents, weights of high-speed steel rounds, tapers, and standard keyways. The sizes of cutters listed conform to the suggestions for simplified practice in milling proposed by the Hoover committee.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of MACHINERY, published monthly at New York, N. Y., for October 1, 1926.

State of New York }
County of New York } ss.

Before me, a Notary Public, in and for the state and county aforesaid, personally appeared Edgar A. Becker, who, having been duly sworn according to law, deposes and says that he is the treasurer of the Industrial Press, Publishers of MACHINERY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Industrial Press, 140-148 Lafayette St., New York; Editor, Erik Oberg, 140-148 Lafayette St., New York; Managing Editor, None; Business Managers, Alexander Luchars, President, 140-148 Lafayette St., New York, and Robert B. Luchars, Vice-president, 140-148 Lafayette St., New York.

2. That the owners of 1 per cent or more of the total amount of stock are: The Industrial Press; Alexander Luchars; Alexander Luchars, Trustee for Helen L. Ketchum, Elizabeth Y. Urban, and Robert B. Luchars; Matthew J. O'Neill; Louis Pelletier; and Erik Oberg. The address of all the foregoing is 140-148 Lafayette St., New York.

3. That there are no bondholders, mortgagees, or other security holders.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

EDGAR A. BECKER, Treasurer

Sworn to and subscribed before me this 17th day of September, 1926.

CHARLES P. ABEL,

(SEAL) Notary Public, Kings County No. 153
Kings Register No. 7006
New York County No. 49. New York Register No. 708
(My commission expires March 30, 1927.)